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CONTENTS.

ILLUSTRATED ARTICLES: PAGE
The Hermite Electro-Bleaching Process ... 2
New Perret Motors ... 2
The Sprague Improved Electric Railway Motor ... 3
The Chretien Elevator at the Paris Exposition ... 4
Some Recent Electrical Work on the Elevated Roads and its Bearing on the Rapid Transit Problem. By Leo Daft ... 5
The Tesla Self-Starting Alternating Motor System ... 9
On a Shunt Transformer. By E. W. Smith ... 9
An English Electric Pumping Plant ... 9
The Glendale Lightning Arrester ... 9
Lang Automatic Water Gauge ... 10
The Gardner Automatic Vertical Engine and Boiler ... 10
The Electric Railway at Bangor, Me ... 10

NEW BOOKS:
"The Electric Railway." By F. H. Whipple ... 2

CORRESPONDENCE:
Fireproofing Armatures. By J. H. Bickford ... 4
What Shall We Do With Our Watches? By "Railway," Dr. O. A. Moses and C. K. Giles ... 8

EDITORIAL:
Paragraphs ... 1
National Ownership of Telegraphs ... 1

MISCELLANEOUS:
Arc Light Carbons. By L. B. Marks ... 2
Bichromate Batteries ... 2
Zigang's Telephone ... 2
Brush Compound Winding in England ... 3
Electricity from Heat. By G. D. Shepardson ... 3
Good Motor Work. By Cecil P. Poole ... 4
A Peculiar Ground. By W. J. P. ... 4
On the Effect of Placing a Ball and Point in a High Tension Alternating Current Circuit. By G. L. Teeple and W. K. Archbold ... 10
Cornell Electrical Notes ... 11
Board of Electrical Control ... 11

SPECIAL CORRESPONDENCE:
New York Notes, 11; New England Notes, 11; Western Notes, 12; English Notes ... 13

DEPARTMENTS:
The Telegraph, 13; The Telephone, 13; The Electric Light, 13; Applications of Power, 13; Personals, 13; Miscellaneous, 14; Business Notices ... 14

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS ... 14

VOL. XIV. NEW YORK, JULY 6, 1889. No. 1.

Self Starting Alternating Motors. A SHORT time since in controverting the claims of some foreign inventors, Mr. Tesla referred to the fact that he had constructed an alternating current motor which could be run on the ordinary two-wire system. An interesting modification of this system is that described in another column, by which Tesla machines on such circuits are enabled to start themselves and to be brought up to speed without external aid. While we believe Mr. Tesla has succeeded in effecting self-starting in such motors without the aid of the temporary ground circuit, the knowledge of this method may prove of value in other fields of electrical work.

Arc Light Carbons. WE print this week several abstracts of the theses presented by the graduates of Cornell University which show more care in their preparation than the average production of this class and reflect great credit upon the course of study provided for at Cornell. Among these the thesis of Mr. Louis B. Marks will be of special interest to the manufacturers of arc light carbons, as it embodies the enunciation of an important law connecting the life of the carbon with its sectional area and resistance and, in addition, brings out the effect on the light-giving efficiency of molded and forced carbons when burned on "low tension" and "high tension" arc systems. From the law, as given, it follows that copper-plated carbons, being of lower resistance than the unplated, are longer lived, and this well-known fact is again affirmed by direct experiment.

Electric Railway Motors. THE rapid changes and improvements which are going on in the construction of electric railway motors have already resulted in what may be considered standard types of such machines. This is well exemplified in the Sprague motor illustrated on another page, which shows the latest development and in which some new features are embodied. Besides the complete waterproof protection now being generally introduced, we note the addition of a shield for the prevention of sparking due to the extra current produced by the variations in the strength of the field magnets. We note also the general adoption of the graphite brush in street car work which, though apparently a small improvement, has nevertheless added much to the smooth running of the machines. Modifications such as these are rapidly bringing the street car motor up to an almost ideal perfection.

Electricity on Elevated Railroads. THE ease with which electricity is supplanting the horse on street railways makes it but natural to suppose that, though the steam locomotive is a more powerful antagonist, electrical engineers will not rest content until it also is banished not only from the surface of the street, but from within the limits of cities entirely, and especially on the system of elevated railways of New York or those contemplated in other cities. Among the experts who have paid special attention to this problem is Mr. Leo Daft, who was the first to attack the problem in a practical way by the actual placing of a motor on the tracks of the elevated railway. The conditions of working were of such a nature that progress was necessarily slow, and it is but now that we are afforded an opportunity of learning the result of what must be looked upon merely as preliminary tests. These are given by Mr. Daft in his paper read last week before the American Institute of Electrical Engineers. Taking up the question of tractive power first, Mr. Daft, notwithstanding the doubts expressed from many quarters, still insists on the increased tractive power of the electric locomotive based on actual tests, and infers from them that an increase in tractive effort of at least 30 per cent. is realized, due to the passage of the current from wheel to rail. This, of course, is considerably less than was obtained from the first experimental tests of this action, but if it can be borne out in practice it will be a valuable factor in this particular instance. Indeed, Mr. Daft claims that the performances observed on some steep grades in electric street railway work are due to this action, as yet little understood. As another factor influencing the tractive effort in favor of electricity, there is cited the continuous effort exerted by the electric locomotive as compared with the intermittent action of the effort exerted by the reciprocating pistons of the steam locomotive. There seems to be little reason to doubt that the gain due to this continuous action must be a marked one and is of special importance in its effect on the starting of a train, allowing of a quicker and smoother "getting away" from a station than could be obtained with steam locomotives. Those interested in the question of operating expenses of such a system, and the power required to drive trains on the elevated railroad, will do well to study the figures given by Mr. Daft and more particularly the diagrams illustrating the power called for at varying gradients and speeds. These diagrams, apparently anomalous in certain places, show excellently the necessity of studying accurately the nature of a road before entering upon its electrical equipment and laying out its prime motive power plant. From the experiments thus far made, Mr. Daft concludes that with a motor equal in weight to the steam locomotives now employed he will be able to haul loads exceeding by more than 50 per cent. those handled at present, and with a saving in operating expenses. It is to be regretted that Mr. Daft confined himself merely to power measurement at the station by means of the indicator, leaving out of consideration all electrical measurements; but as stated by him he wished merely to give the results of work preliminary to that which he expects will solve the problem not of equal, but increased facilities on the elevated railroads by the aid of electricity.

NATIONAL OWNERSHIP OF TELEGRAPHS.

The old but still unsettled question of government ownership of the telegraphs is taken up and discussed by Prof. R. T. Ely, of Johns Hopkins University, in the *North American Review* for July. The article is interesting, but we are sorry to say that there is nothing particularly new in it. As our readers are aware, Prof. Ely is one of those who believe that unofficial men manage their business so badly that other men, officials with titles, are needed to manage it for them. It will be remembered that he has lately been advocating municipal ownership of electric light plants on the ground that political city officials, with a plant bought out of the proceeds of taxation, can run the plant to better advantage than private individuals or companies can whose aim is to get as good a dividend as possible by dint of hard work and by rendering such service as will secure the largest number of customers.

One of the main arguments against government telegraphs has been the increase of political patronage that it would involve. Professor Ely says, however: "I believe no assertion is safer than the prediction that the purchase of telegraph lines would improve our civil service immediately, and soon lead to measures which would diminish the patronage of elected office holders." If Professor Ely were a new-born innocent living in the moon, we could tolerate this remark, but it is hard to credit the fact that it comes from a public teacher living within a few miles of Washington, which has just seen the greatest rush on record for offices far short of the demand, and in a year, too, when the temporary positions created by the work of census-taking are hailed with delight by politicians as a "measure of relief." Control of the telegraphs would place at least 30,000 salaried positions at the disposal of the party in power, and of these 5,000 would be held to be legitimate spoils of the victor. Does anybody seriously believe that either party or any party would relinquish those "offices" if they were once within grasp? The answer to that question may be found in what is now going on in the decapitation bureau of the Post-Office department.

"How simple the post-office business!" ejaculates Prof. Ely. Certainly! how simple! What part of it does the government actually direct, after all? It merely collects the letters and delivers them, and often does not do even that. The mail wagons are owned by private individuals, the steamers are owned by private individuals, the railroads are owned by private individuals, and the very post-offices themselves are hired on lease. Yet this is the business that is held up as a reason for government monopoly of the telegraph. Besides, Prof. Ely says: "Finally, a world telegraph union has been discussed, and it would bring great advantage, as has the Universal Postal Union; but the chief obstacle in the way has been the private telegraphs of the United States. If we in this country buy the private lines and establish a public service, a world telegraph union will soon be formed, and that will be another one of those bonds which unite nations and make for international peace." Then Professor Ely proposes to buy and operate all the ocean cables too. Has he the remotest conception of the cost involved in purchase and maintenance? And then if the telegraphs and cables be bought, the telephones and district messenger services must go as well. In other words, the cool proposal is that the country shall invest anywhere from $250,000,000 to $500,000,000 in buying the plant now in use in private hands.

Prof. Ely remarks: "It is, however, urged that public ownership of telegraphs is a step toward socialism. Why does not the government bake bread for us as well as send telegrams? Questions like this are asked. Manifestly the two functions are not analogous. One is a natural monopoly; the other not. The tendency to absorb natural monopolies shows no tendency to absorb all business." It would seem that Prof. Ely considers telegraphing more "natural" than bread baking. We know a community in the West Indies where bread baking has become a distinct "natural monopoly," like gas making, through the enterprise of two colored men, who deserve every cent they have made. In that community the government owns the telegraphs. Does Professor Ely mean that it ought to do the bread baking there, too? We know a community nearer home where the handling of oil, a prime necessity, has become a practical monopoly. Is the government to buy out the oil-well men and all the oil properties? What would people fifty years ago have said when told that the telegraph was a "natural monopoly?" They did not even know the word telegraph. Besides, Professor Ely talks ominously about gas plants and street railways, the product of the last half century. Are they also to be considered "natural monopolies," and bought up?

Professor Ely begins his article by speaking of "something ludicrous in the surprise and consternation expressed by the general public when it became known that the Western Union Telegraph Company had acquired the lines of the Baltimore & Ohio." We can recall no such display of emotion, but we do recall the fact that although the opposition was in good shape, Mr. Robert Garrett's condition of mind and body for some time previous had made it evident that a consolidation would probably be effected, and the transfer took place without very great ado. Incidentally we may note that Professor Ely quite overlooks the fact that the Postal Telegraph Company is to-day in active and prosperous existence, and that there are 60 or 70 distinct telegraph companies in the country.

We are no lovers of the Western Union, and we have no occasion to love it, but we prefer its service and the conditions of its existence to anything that Europe or Asia can show, with their telegraph lines under absolute control for the promotion of dynastic and political ends, and with a personnel that is depressed and discontented and in incessant agitation and protest, from one end to the other.

NEW BOOKS.

The Electric Railway. By Fred H. Whipple, Detroit, Mich., 1889. Illustrated, 9 × 5¼ in., 259 pp. Price, $1, paper.

This is a popular treatise of a commercial nature on the subject of electric railways, in which a large amount of miscellaneous matter has been brought together and ingeniously classified. Mr. Whipple is not an electrician, and, therefore, does not claim to enter into any authoritative disquisition on the subject in its scientific relations, but enough is given of the principles involved to enable any one interested to grasp their meaning and bearing. No authorship is mentioned for this part, but the style is very happy and graceful; and it strikes us as perhaps being from the pen of Dr. Park Benjamin. A large portion of the book is devoted to a description of the leading electric railway systems and of the roads that are now in operation. Other chapters are devoted to such subjects as engines, turbines, belting, car-wheels, etc., in which leading types and makes are described.

The book is wanting in statistics such as of late have been abundant in regard to the exact cost and efficiency of electrical operation, and it is also unfortunately without an index. Aside from these matters and some electrical errors that need not, however, be touched on, it is a praiseworthy attempt to do justice to a great and growing industry, and will no doubt serve the author's purpose.

Arc Light Carbons.*

BY LOUIS B. MARKS.

Although in all probability a great amount of work has been done upon the subject, the publication of *facts* concerning the modes of manufacture, the laws of candle-power, life and efficiency of arc-light carbons has, until recently, been very limited in extent.

It is not proposed in this brief sketch to go fully into these matters but merely to mention, among other things, a few facts heretofore unpublished, throwing some light on this important subject.

The question has been asked†, in what manner and to what extent the size of the carbon affects the results in a current of given strength, covering of course, in the general question of conductivity, the all-important results of light and life.

The conclusion has been drawn from a multitude of experiments that with carbons of the same manufacture and type the *life of the carbon varies directly with its diameter and inversely with its resistance.* Thus the life of a one inch Brush carbon having an actual diameter of .986 inches and a resistance of .061 ohm is, according to test, 26.15 hours. According to the law above stated the life of a five-eighths inch Brush carbon having an actual diameter of .618 inch and a resistance of .0735 ohm would be by calculation 13.62 hours. When put to test, this carbon burned 13.64 hours. Many other examples might be given here but lack of space prevents. In the law stated above it is understood that the relation holds true only when the current and the difference of potential between the terminals of the lamp are kept constant in all cases.

We are in the habit of refering to those systems in which a small current and a long arc are used as high tension systems, and those in which a large current and a short arc are used as low tension systems. It has been found that, generally speaking, a *molded* carbon is superior for high tension and a *forced* carbon for low. Forced carbons are made by pressing the mass through a die of given size after the fashion of "squirting" lead pipe. The following figures speak for themselves:

TESTS OF EFFICIENCY.

High tension	⅛ inch molded carbon;	efficiency	= 11.71	per cent.
	⅛ inch forced	"	= 8.88	" "
Low tension	¼ inch molded	"	= 9.32	" "
	¼ inch forced	"	= 11.05	" "

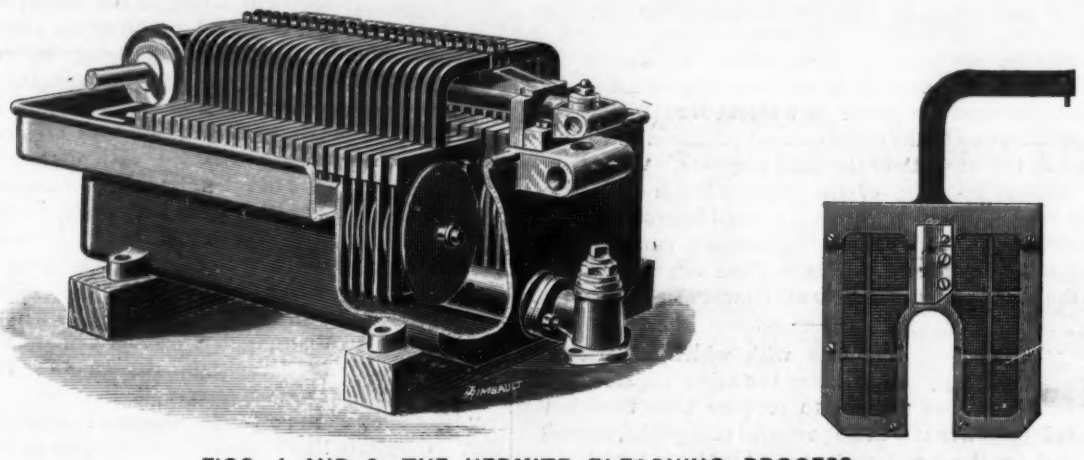
From the candle-power and efficiency tests of carbons it has been determined that the efficiency of a copper plated carbon is exactly the same as that of an unplated carbon of the same diameter, although the life of the former be from 30 to 40 per cent. longer than the latter.

*Abstract of Thesis.—Cornell *Crank.*

† Paper read before National Electric Light Association, by F. W. Parker, February, 1888.

The Hermite Electro-Bleaching Process.

In our issue of Feb. 9, 1889, we described and gave an illustration of the interesting process devised by M. Hermite for the bleaching of paper and wood pulp by electrolytic action. The process has been successfully introduced in a number of mills abroad, and has been installed in the paper mill of Messrs. S. D. Warren & Co., at Yarmouthville, Mass. The Hermite process, it will be remembered, is based upon the fact that when an aqueous solution of magnesium chloride (consisting of 5 per cent. of magnesium chloride and 95 per cent. of water) is electrolyzed in a suitable apparatus, this salt is decomposed at the same time as the water.



FIGS. 1 AND 2.—THE HERMITE BLEACHING PROCESS.

The nascent or newly liberated chlorine of the magnesium chloride and the nascent oxygen of the water resulting from the electrolysis unite at the positive pole, and produce an unstable oxygen compound of chlorine of very high bleaching power. The hydrogen and the magnesium go to the negative pole; this last decomposes the water and forms magnesium oxide, while the hydrogen is disengaged. If in this liquid, colored vegetable fibres are introduced, the oxygen compound acts on the coloring matter, and oxidizes it. The chlorine combines with the hydrogen to form hydrochloric acid, which, finding itself in the presence of the magnesia, combines with it and forms the initial chloride of magnesium. Thus a complete regeneration takes place so long as the electric current acts on the solution in presence of coloring matter. The cycle is a perfect one, in which there are four elements—the electric current, chloride of magnesium, the water, and the coloring matter. Only two of these elements are used up in bleaching the coloring matter—the electric current, or, what is the same, the motive power and the water. The chloride of magnesium thus serves over and over again. There is only a simple displacement of molecules, and the chlorine acts as a vehicle to discharge the nascent oxygen on the coloring matter.

The apparatus required for the process has been constructed by Messrs. Paterson & Cooper, of London, Eng., and is quite simple in its nature. The engraving, Fig. 1, represents one of the types of electrolyzer, which is ordinarily used for bleaching paper pulp. It consists of a galvanized cast iron box, having at the bottom a perforated pipe fitted with a cock, through which the magnesium chloride solution is admitted to the electrolyzer; the top of this box is surrounded by a channel, in which the solution is received on overflowing the sides of the box; from this channel it is carried away by means of a pipe, thus keeping up a continuous circulation. The negative electrodes are shown and consist of a number of zinc discs arranged upon two spindles, which are caused to revolve slowly by means of worms and worm wheels. Between each of these zinc discs is placed a positive plate, shown in Fig. 2. The active surface of the positive plate is composed of platinum gauze mounted in a frame of ebonite to give it stiffness; each of these sliders or positive plates is connected to the copper bar shown above the box by means of a stud and nut and can be removed at will while working. The positive terminal of the dynamo is connected to this copper bar, and the current distributes itself over the whole of the platinum plates, from which it passes through the solution to the zinc discs (negative plates), which are in contact with the iron box to which the negative pole of the dynamo is connected.

A current of 1,000 to 1,200 ampères is employed in the process. Each electrolyzer, working 24 hours, will produce bleaching power equal to about 275 pounds of English bleaching powder, at 33 per cent. chlorine, and requires about 8¼ horse-power.

The electrolyzers do not require any special attendance or care. About every month the mud-hole at the bottom of the electrolyzer must be opened, and the apparatus thoroughly washed out with water by means of a rubber hose. This is done without taking the electrolyzer to pieces, or stopping the working of the plant.

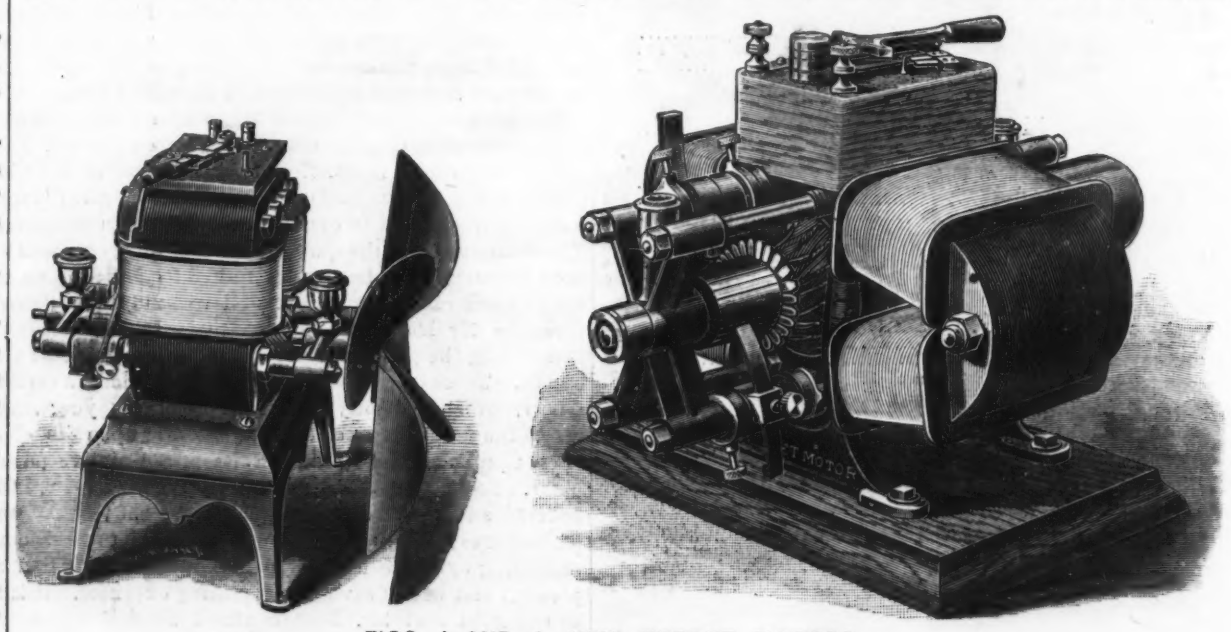
Bichromate Batteries.

From some late experiments with bichromate cells without diaphragms it has been concluded that a useful form is that where the cells have a height greater than their diameter, and contain about six litres of a solution of 12 parts of bichromate of sodium in 100 parts of water, to which 25 parts of sulphuric acid have been added. If one square decimetre of zinc is thus exposed to the solution, it will not need to be changed for two hours. Owing to their very low internal resistance, these cells can be conveniently used for working incandescent lamps coupled in parallel. On account of the small quantity of material required, the difficulty of crystallization, and the low price of the material, the bichromate of sodium is to be preferred to the potassium salt or to chromic acid. The depolarization and E. M. F. is greater with porous carbon than with hard, close-grained carbon. The zincs used should be free from carbon and iron, since, if the cells are coupled in parallel, local action may be set up.

New Perret Motors.

We have already had occasion to describe the series of motors designed by Mr. Perret, electrician of the Elektron Manufacturing Company, of this city, and are now able to illustrate two more, recently added. The engraving, Fig. 1, represents the ⅛ h. p. fan outfit, mounted on a base, and wound to run either from a battery or an incandescent light circuit.

The illustration, Fig. 2, represents the type of machine built for ½ h. p. and upwards. In these machines the consequent pole type of field magnet is employed. These magnets, as in the smaller machines, are built up of soft sheet iron and laminated so as to avoid all eddy currents.



FIGS. 1 AND 2.—NEW PERRET MOTORS.

A switch for starting and stopping is placed on top of the motor, and resistance coils are used for starting, which are automatically inserted, thus avoiding the use of a separate rheostat. The machine illustrated runs at 2,000 revolutions and weighs 70 pounds.

Zigang's Telephone.

The principal point in connection with Captain Zigang's electro-magnetic telephone seems to be his discovery "that when a telephonic membrane is acted upon by an undulating current through the intermediary of an electro-magnet the currents obtained are, up to a certain limit, more intense and more distinct, as the size of the membrane is limited and its elasticity increased." The apparatus is constructed in conformity with this theory, and is said to possess an advantage over magnetic telephones in that it is less affected by induction currents from neighboring wires.

The Sprague Improved Electric Railway Motor.

We publish in this issue two views, Figs. 1 and 2, of the Sprague improved electric motor for street railway work. This motor represents the experience of several years in the electric street railway business, and it is intended to meet all the exigencies in this kind of work. In its construction every detail, mechanical and electrical, is carefully attended to, and the most recent improvements which experience could suggest have been adopted to meet the necessities of street car service.

Only one intermediate shaft is used between the armature pinion and the main gear, and the entire reduction is about 12 to 1. All the gears and every part of the motor are made extremely strong and durable, as can be seen in the case of the gears in the engraving, where the general appearance of durability and strength is very strongly marked. The main gears are of the split-gear pattern, so that in case of necessity they can be easily removed from the shaft without dismounting the machine. The pinion and all the bearings are also constructed so that they can be independently removed, if necessary.

Great attention has been paid in this motor to obtain a machine, which will require a minimum amount of attention and care, and will work under the unfavorable conditions which motors for street railway work very often meet in actual practice. For this reason, all the bearings are made as simple as possible and protected from the weather by dust guards.

The armatures are of the type which has been proved to be water-proof and incapable of injury by moisture. In a recent test upon one of these armatures, made at the Sprague factory at Schenectady and described in this paper a short time ago, it was placed in a tub of fresh water and allowed to remain there for twenty-four hours, and then in a tub of salt water and once more submerged for the same time. After each of these baths, the armature was placed in position in the motor and the machine was worked to one-third above its normal load as measured by a dynamometer for several hours without developing any trouble whatever. These tests proved most conclusively that these machines can be relied upon under all conditions of weather, and that they cannot be harmed by moisture or by water splashing upon them from the road-bed.

Another important improvement which has been adopted in this machine, is, that the field magnet coils are completely incased, as shown in the engraving, a plan fully protects the wire from all outside damage. These casings are hermetically closed, so that it is impossible for any moisture to affect the coils in any way. Besides acting as protectors against any moisture, these casings also have an important electrical action in protecting the coils, since, being made of copper, by inductive action they reduce to insignificance whatever extra current might be generated in the coils upon breaking the circuit. This action is highly important, and its value cannot be too highly estimated.

The regular Sprague graphite brush is used upon these motors, which has been shown to give such excellent results in this kind of work. The graphite, instead of cutting the surface of the commutator, as brushes made of copper and other materials have been proved to do, acts as a lubricant, keeping the commutator smooth, at the same time giving very good electrical connection.

The method of flexibly suspending the motors, which is an original and very important feature of the Sprague system of railway work, and the method of starting, stopping and graduating the speed of the motor without the use of any wasteful resistance, is in use upon all the roads installed by the Sprague Electric Railway and Motor Company.

A great deal of attention has been paid in the design of this motor to the matter of reducing the weight to a minimum while paying sufficient attention to durability and strength. With this object in view, cast iron has been dispensed with entirely in the magnetic circuit, and wrought iron substituted; the increased cost of this substitution is more than made up for in the increased efficiency obtained with the same weight.

The practical test of these machines on such roads as Atlantic City, Cincinnati, Wichita, Cleveland and Chattanooga proves that the claims made for them have been realized, and that the motors will actually do what is asserted of them. The machine as it stands is a good example of systematic and logical evolution toward perfection of type.

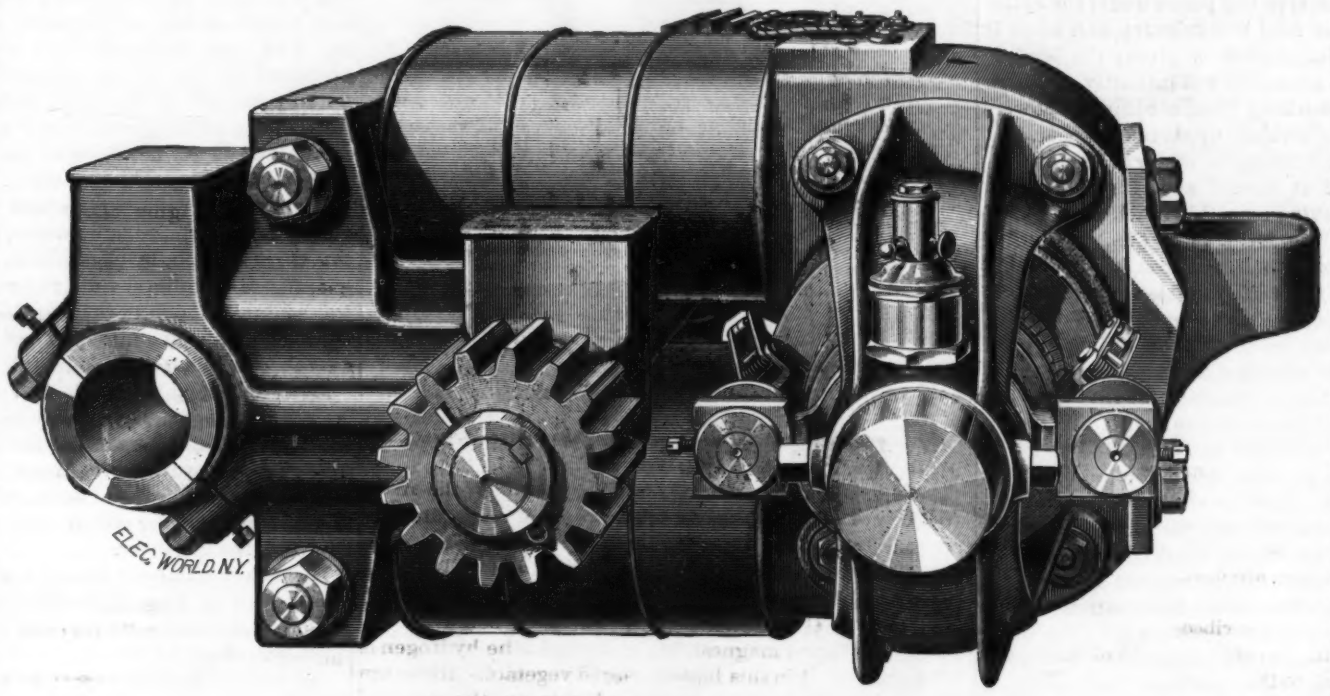


FIG. 1.—NEW SPRAGUE ELECTRIC RAILWAY MOTOR.

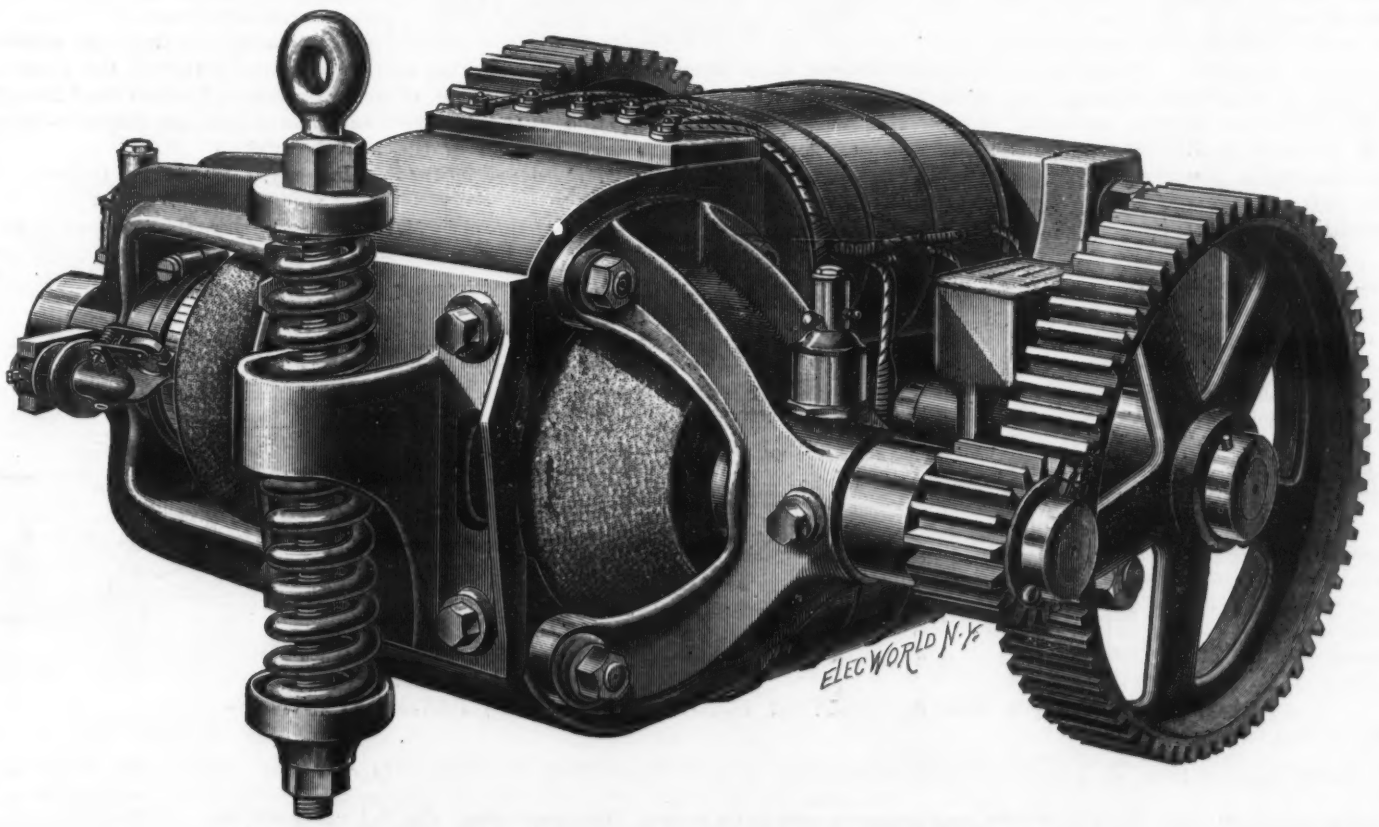


FIG. 2.—NEW SPRAGUE ELECTRIC RAILWAY MOTOR.

Brush Compound Winding in England.

Special Cable Dispatch to The Electrical World.

LONDON, June 26, 1889.—An important decision has been made by the Court of Sessions at Edinburgh in the litigation touching the Brush patent on the compound winding of dynamos. The court has invalidated the patent on the ground of Varley's prior use and publication of that method of securing regulation.

Electricity from Heat.*

BY GEORGE D. SHEPARDSON, A.M.

The thesis contains an historical and theoretical study of the different methods for transforming the latent energy of fuel into electrical energy, being preparatory to an investigation of a new method.

The high efficiency of most electrical transforming devices and the ease of obtaining heat from electricity indicate the possibility of some electrical method of getting cheap power from coal, to excel the 10 per cent. efficiency of the steam engine.

The different methods fall into two general classes accordingly as they work by a changing temperature or by a constant difference of temperature in different parts. The first includes pyroelectric crystals, which are hardly adapted for commercial generation of electricity, and pyromagnetic motors and generators. A provisional theory for the latter gives a maximum thermodynamic efficiency of .016 on one hypothesis, or of 0.000,000,005 on another, the former being the more probable.

The second class is represented principally by the thermopile, whose efficiency is impaired by the conduction of heat from the hot to the cold junction, the highest theoretical efficiency for any combination yet tried being 0.12, while the highest actually attained and published is 0.0054. The thermopile is compared to a galvanic cell whose electrodes touch within the cell, the external effect being almost nullified by local action. Clamond has partially avoided this fault in recent types (1886), said to surpass all others in efficiency.

By substituting an electrolyte for one metal of a thermopile, the efficiency is greatly increased and different gases have been introduced into the circuit with advantage. Attempts have been made, with indifferent success, to substitute carbon for the zinc of a galvanic cell, and to use the burning fuel as one electrode of a battery. One method uses the increased solvent power of liquids with rising temperatures. The most recent method is to increase the output of an alternating current transformer by heating the secondary coil.

On the whole, the prospect is encouraging for obtaining cheap power by the direct conversion of heat into electricity, a problem that is now engaging the attention of the foremost electricians of the age.

* Abstract of Thesis.—Cornell *Crank*.

Good Motor Work.

BY CECIL P. POOLE.

A good deal has been said setting forth the superiority of electric over small steam power, and not a few instances have been cited wherein unusually excellent work has been performed by motors of various types.

Remarks tending to a comparison of electricity with steam would ordinarily be trite and superfluous at this late day when steam advocates have wisely recognized the futility of argument on the subject, but the writer cannot resist the impulse to add one more small link to the already long chain of electrical triumphs.

For hard conditions and abnormal strains a cylinder printing press running alone probaby leads the industrial world. The load varies at least "200 per cent." between each impression; when the type bed passes under the cylinder for an impression the load is maximum, and when it starts back, after the impression is given, the load is minimum, changing not gradually but instantly. Where a number of presses are working from a common power, the variations of load are divided up between them, and do not show to such an extent at the motor or engine.

Under the conditions first named above, a little 2 h. p. Eickemeyer motor is working smoothly and almost silently in the press room of the Lynchburg (Va.) *Daily Advance*, taking the place of a 3 h. p. steam engine, which changed speed perceptibly at each variation of the load, so suddenly were these variations thrust upon it. The speed of the engine dropped from 300 to 240 revolutions at each increase of the load. The press is a large Campbell cylinder, with an automatic folder attached which enhances the roughness of the work about five per cent. When the press is doing its hardest work the folder is grinding away at its worst, and at the moment when the press lets up the folder becomes idle, making the increase and decrease of the load something terrific; yet the motor sings merrily along through it all, never sparking or heating, and apparently unconscious of the fact that an ammeter placed in the armature circuit dances spasmodically from 3 to 18 ampères and back again 1,500 times per hour, or 25 *times per minute*. The speed of the motor does not change perceptibly, and the brushes have not been reset or wiped once during the past two weeks. Surely no better practice can be attained without investing a motor with a set of brains, and it is doubtful if this would work improvement upon the performance of this Eickemeyer motor.

The Chretien Elevator at the Paris Exposition.

Our readers are already aware that one of the elevators of the Eiffel tower at the Paris Exposition is operated by electricity. Besides this tower, however, there are several minor ones in the Exposition, among them being those placed at the side of the façade of the Machinery Palace. These towers, which are shown in the accompanying illustration, Fig. 1, are 33 metres in height and surmounted by a lantern which contains a powerful arc light, the total height being 44 metres. Within these towers run elevators operated by electricity on the system of M. Chretien. For this purpose a Gramme generator, delivering 50 ampères at 200 volts, is situated in the machinery gallery of the Compagnie Electrique, and at a distance of about 250 metres from the tower. Two Gramme motors connected in series are situated at the top of the tower, and receive current from the generators.

The arrangement of these motors is shown in Figs. 2 and 3. Each of the machines drives a horizontal shaft through the medium of a special clutch coupling. One-half of the clutch coupling contains the projections, which are covered with rubber and which fit exactly into recesses in the opposite half of the coupling. These rubber cushions perform two functions, viz., that of insulating the electric machinery, and, next, tending to relieve the machinery of all shock on starting or stopping. The horizontal shafts driven by the motors are provided with worms which gear into worm wheels in the manner shown in the illustration, taken from *La Lumière Electrique*.

The speed of the elevator is varied by the introduction or removal of resistances arranged at the top and at the bottom of the tower. For that purpose four conductors are strung along the full height of the tower. One of these leads to the generator, two others are connected to the brushes of the motors, and the fourth is connected with the field magnets of the motors. The conductor leading to the generator is divided into short sections at the top and the bottom for a distance of about four metres. These sections are united among themselves by German silver resistances. The last section alone effects a complete breaking of the circuit, which is accomplished when the brushes carried by the elevator car touch that section;

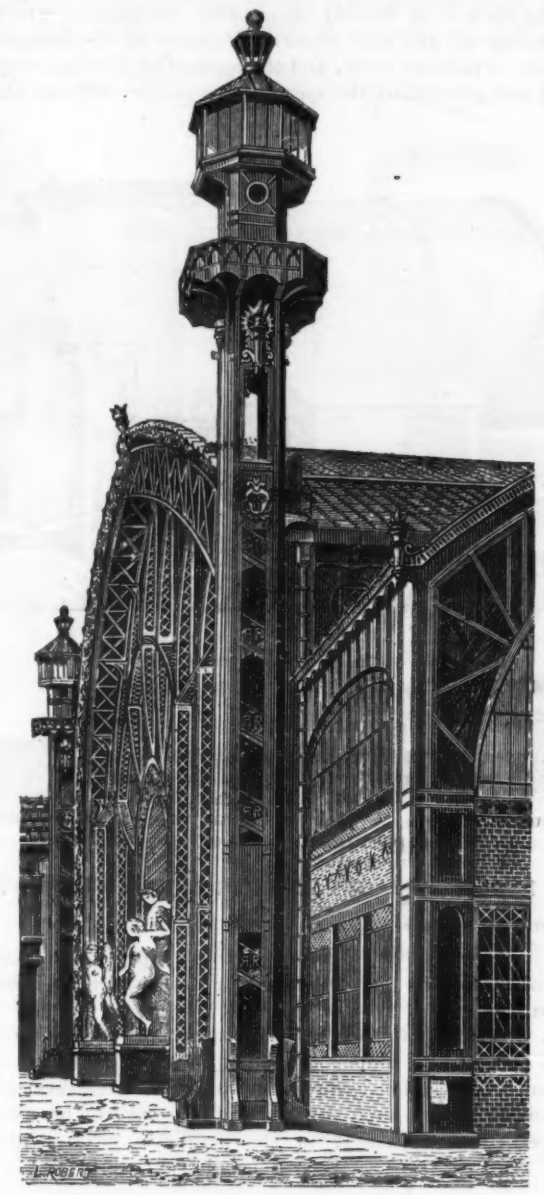
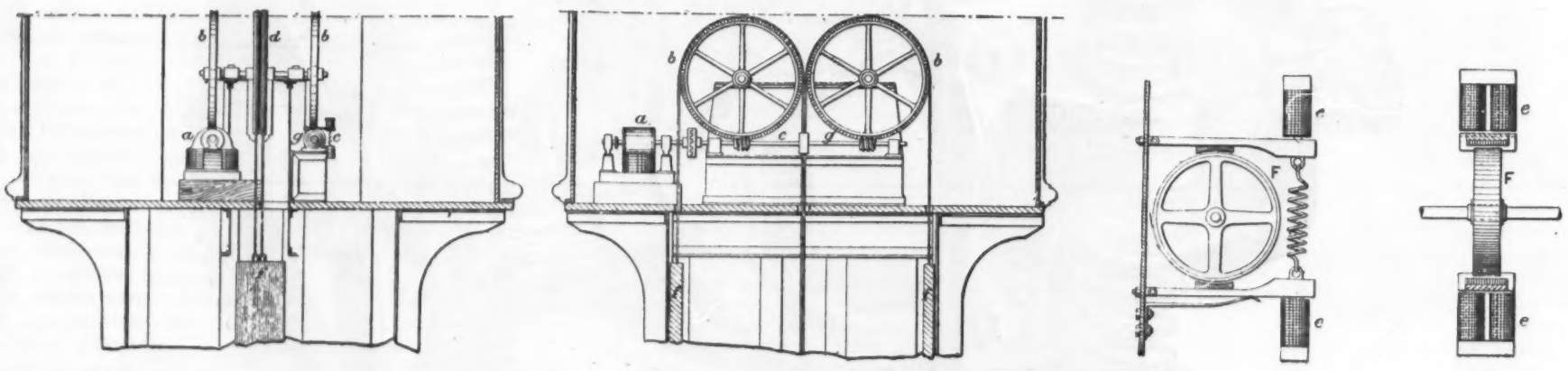


Fig. 1.—Chretien Electric Elevator, Paris Exposition.

thus the elevator stops automatically. The current is taken from these conductors strung up the side of the tower, by means of brushes situated at the side and top of the car. Another rheostat under control of the elevator man allows the speed to be regulated by that means also.

A very ingenious attachment has been introduced by M. Chretien, in the shape of an automatic brake for stopping the car. The arrangement of this is shown in Fig. 4. The brake pulley *F* is situated between two brake levers provided with friction shoes. These levers are pivoted at one side, and their other extremities are connected by means of a spring sufficiently powerful to stop the machinery without additional aid. Two electro-magnets *e e* attract their armatures, which are attached to the brake levers, so that when the normal current passes through the motors and these magnets, the attraction is sufficient to keep the brake shoes out of contact with the pulley. Upon the current strength diminishing, however, by the introduction of the resistance of the circuit, the attraction of the armatures is reduced. The spring then predominates and, pressing the brake shoes against the pulleys, slows down their motion, and when the current is finally shut off, the friction is sufficient to stop the elevator entirely. In this way the car is stopped without the slightest jar.



FIGS. 2, 3, 4 AND 5.—CHRETIEN ELECTRIC ELEVATOR, PARIS EXPOSITION.

A Peculiar Ground.

BY W. L. P.

A short while ago an incident happened in connection with the Edison three-wire system under Boylston street, Boston, which is interesting both to the electrician and the chemist. It was noticed that the horses were very uneasy and somewhat scared when passing over an area of, say, ten feet square in the granite pavement of the street. An investigation by the Edison people seemed to show no trouble, and everything went right for ten days or more, when, during a rain storm, the same action of the horses was noticed.

Upon digging down to the wooden box which contained the three wires of the system, embedded in some kind of tar or bitumen compound, a spot was found where the box was eaten through, and a large mass of sticky stuff was found around the negative wire. The insulation of the wire was destroyed, and as the neutral is dead grounded in the station there was a leakage, causing a fall of potential in the earth about the leak which was sufficient to affect horses as well as men. The leak was a small one and did not show at the station.

Chemical examination of the lump showed that it was originally concentrated lye which had become partly converted into caustic soda by water, and that the action of the currents had, by electrolysis, formed a considerable quantity of metallic sodium throughout the mass. There was sodium enough present to make a fair display of fireworks when thrown into a pool of water, and it is fortunate the workmen did not get into trouble in handling it.

My theory of the affair is this: In some way a piece of lye tumbled into the kettle in which the insulating compound was made and was not noticed when the box was filled. In time surface water got at this lump and converted a part into caustic soda, which destroyed the box and insulation of the wire (it only came in contact with one wire, the negative).

The escaping current caused a difference of potential at the surface of the ground which disturbed the horses. Metallic sodium was set free and would tend to collect at the negative wire.

The voltage at the escape was in the neighborhood of 105 volts, and it was estimated by the touch that there was over 50 volts within the space that a man could reach with both hands.

Fire-Proofing Armatures.

To the Editors of The Electrical World:

I notice in your issue of June 29 another communication from Mr. H. F. Watts on the subject of fire-proof armatures.

I am sorry to be obliged to repeat what I said in your issue of June 15, that Mr. Watts evidently does not fully understand the requirements of an electric motor when applied to a street car. He remarks that because the whole world sins that is no excuse for us to do likewise; but one would infer from his article that the Sprague Company was doing all the sinning, whereas if he will take the pains to look up the different systems he will find that some of them are deeper in the mire than the Sprague is in the mud.

However, I do not care to discuss the merits or demerits of any particular system.

He further says that the bottom of the car is no place for a motor. Perhaps Mr. Watts has the ideal method of attaching motors to street cars; if so, it seems too bad that he is withholding it from the public while such men as Sprague and Thomson are groping about in the dark. Perhaps his idea is to build a car to suit the motor he would have used. No one doubts that this would be an excellent way out of the difficulty as far as the protection of the motor is concerned; but first Mr. Watts must persuade the railway companies to lay aside their present cars and adopt the new style, which he would find to be a task of no mean proportion.

He says, too, that it would be much more sensible for these people to produce a fire-proof armature, and box it in to protect it from the wet. I would like to have Mr. Watts explain the necessity of protecting a fire-proof armature from the wet. If it is proof against burning out, most surely water cannot affect it.

Boston, Mass. J. H. Bickford.

Some Recent Electrical Work on the Elevated Roads and its Bearing on the Rapid Transit Problem.*

BY LEO DAFT.

It is particularly noticeable that all who have so far considered the question of rapid transit for the city of New York have assumed that it is so deficient in these facilities that the question was one of the most vital importance; and while I do not for a moment wish to underestimate the urgency of the demand to meet the rapid growth which has already almost overtaxed the elevated system, we should not lose sight of the fact that

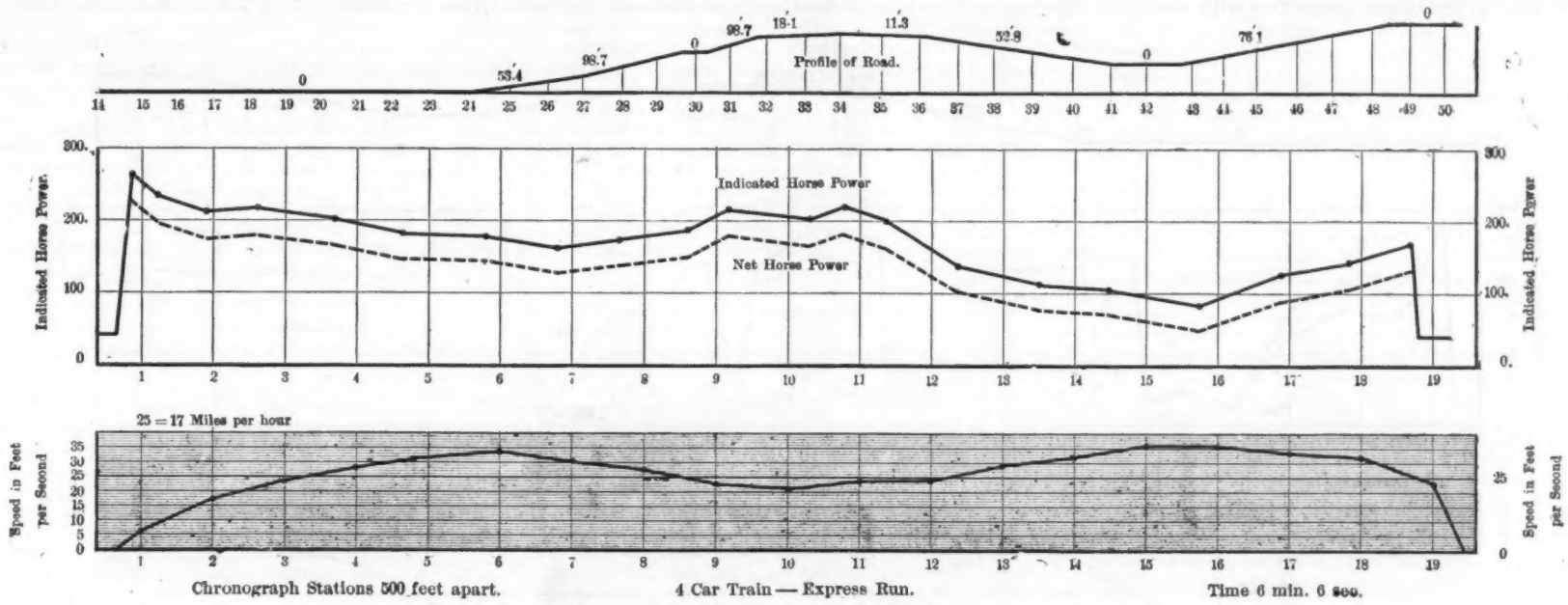

Profile of Road.
Indicated Horse Power
Net Horse Power
Indicated Horse Power
25 = 17 Miles per hour
Speed in Feet per Second
Chronograph Stations 500 feet apart.
4 Car Train — Express Run.
Time 6 min. 6 sec.

FIG. 1.—POWER TESTS ON THE NEW YORK ELEVATED ROADS.

New York has even to-day, all things considered, a better rapid transit system than any other city in the world. In evidence of this it is only necessary to cite the fact that one may enter a well appointed car at the Battery, and, traveling through the best atmosphere of the city, be carried with remarkable smoothness to Fifty-ninth street in twenty-six minutes, or at the average speed of twelve miles per hour, including stops, and in about this manner the elevated system contrives to carry one-half million passengers per diem for a lower rate of fare than is done in any other city for similar accommodation, and with a smaller proportion of accidents than may be found on any steam road in the world, making an equal number of stops per one hundred miles run. On a recent holiday, namely, April 30 last, 835,721 passengers were carried on this much-abused system without noticeable detention or accident; but New York wants more, and, in view of the rapidly growing traffic which has already almost exceeded the ability of the system, it must be admitted that the demand is a pressing one, as this one-half million will grow to one million in a short time, and it is exceedingly improbable that any steam motor can be devised to permit of this increase, at least on the present structures, without subjecting them to quickly destructive strains. With steam, therefore, the only avenue open for increasing the passenger capacity, namely, the use of longer trains, is obviously out of the question, since it is a notorious fact that the present motors are taxed to their utmost.

To the mind of the mechanical engineer, having in view the ordinary coefficients of tractive ability, there is no remedy for this, but I think I shall be able to produce at least some little evidence that, owing to certain effects which have not yet been satisfactorily explained, an electric motor may be made capable of solving the problem at least so far as the ultimate strength of the present elevated structure will permit, inasmuch as the effects alluded to certainly do increase the tractive ability beyond that obtained by the use of any coefficients which may be found in the works of that eminent authority, D. K. Clark, or still later in the excellent treatise on the "Economic Theory of Railroad Location," by A. M. Wellington.

That these coefficients are not absolutely trustworthy is evident not only in the hesitancy with which they are treated by these authors, but also from the fact that varying coefficients are to be found in use by practical men, where the conditions do not differ in any appreciable degree. This is noticeable to the extent of nearly twenty per cent., *vide* D. K. Clark and A. M. Wellington. I will not, therefore, make pretense to great precision on this point, as the matter is one yet under investigation, but to quote an extreme case I trust I may be pardoned for going back so far as the year 1882 to the first series of experiments in which this increased tractive capacity was observed and carried to its apparent maximum.

During a series of experiments with small motors, made at the works of the Daft Company at Greenville, N. J., in the year above quoted, I constructed an adjustable incline upon which a small motor was caused to ascend with a gradually increasing gradient until the extraordinary angle of 2,900 feet per mile, or 54.9 per cent., was reached. Up to this point the motor, weighing 450 pounds, plus one man weighing 150 pounds, total 600 pounds, was readily started from a position of absolute rest at the bottom, and ascended the gradient, being occasionally stopped midway, and started again with perfect ease. When this final gradient was reached, however, the ascension was less easy and certain though it was accomplished several times, but an attempt to exceed it resulting in failure; this was regarded as the maximum under those circumstances.

Now, let us for a moment consider what this actually indicated: A motor having a total weight of 600 pounds will have a rolling resistance certainly equal to 10 pounds per ton, making 2.25 pounds for this item; at 54 9 per cent. the grade resistance will be 320.4, making a total of 331.65 pounds, or 55.27 per cent. of the total weight, considerably more than double the ultimate working limit of adhesion under the most favorable condition cited by Wellington in the work already quoted; but as those conditions, namely, a perfectly dry rail with drivers absolutely free from any lubricant, are so rarely found in practice as to be scarcely worth taking into account in every-day work, it may fairly be considered as equal to three times the ultimate effort usually developed before slipping occurs.

A prominent engineer in dismissing the idea of increased traction due to the passage of a current between the adhesive surface falls into the error of assuming that the effect would be precisely the reverse of that which has been observed, and in support of his argument cites the case of the lessened friction between the metallic points and the cylinder of chalk noted in a well-known instrument. I need hardly, however, call the attention of this audience to the entire absence of any proper analogy between these two cases. That the motor should not have ascended this gradient I am well aware; indeed out of the commonest respect for such authorities as Messrs. Clark and Wellington, it ought to have stopped at the bottom of the gradient, merely rotating its wheels; but I was confronted by the indisputable fact that it did go up, and did it every day with perfect regularity for a number of days before many gentlemen, among whom were mechanical engineers, who could not account for that state of things at all—and, frankly, neither could I, but as a cold fact it outweighed all the arguments in the universe. In illustration of my own doubts on the subject, I may mention a little instance that occurred at that time; I had written to a mechanical engineer of my acquaintance, stating the facts, and received in reply such an astonishing array of diagrams and mathematical proofs that this could not be done, that I actually went out into the yard and had the motor perform the feat several times before I felt strong enough to write my friend in a half apologetic way acknowledging the soundness of his views, but being compelled to reiterate the statement that the thing was being done just as I stated.

But, seriously speaking, the significance of this test can scarcely be overestimated, showing as it undoubtedly did the possibilities of working under conditions which have been hitherto considered impracticable.

Now, I do not for a moment pretend to assert that either dynamic or static adhesion may be increased to this extent by a large locomotive under the conditions of ordinary practice, as I am fully aware from subsequent experiments that the observed effect in this instance was due to a very large current of low potential passing through the very small contact areas presented by wheels one foot in diameter impinging upon a light 16-pound rail. The only effect is, however, undoubtedly obtainable to the extent of at least 30 per cent. under the ordinary conditions of railroad practice, since I have observed it many times with a dynamometer by causing the current to pass from wheel to rail in one series of measurements and through a cable connected with the motor in another series, and in this way results as high as 35 per cent. increase have been many times noted. In addition to this it is more than probable that

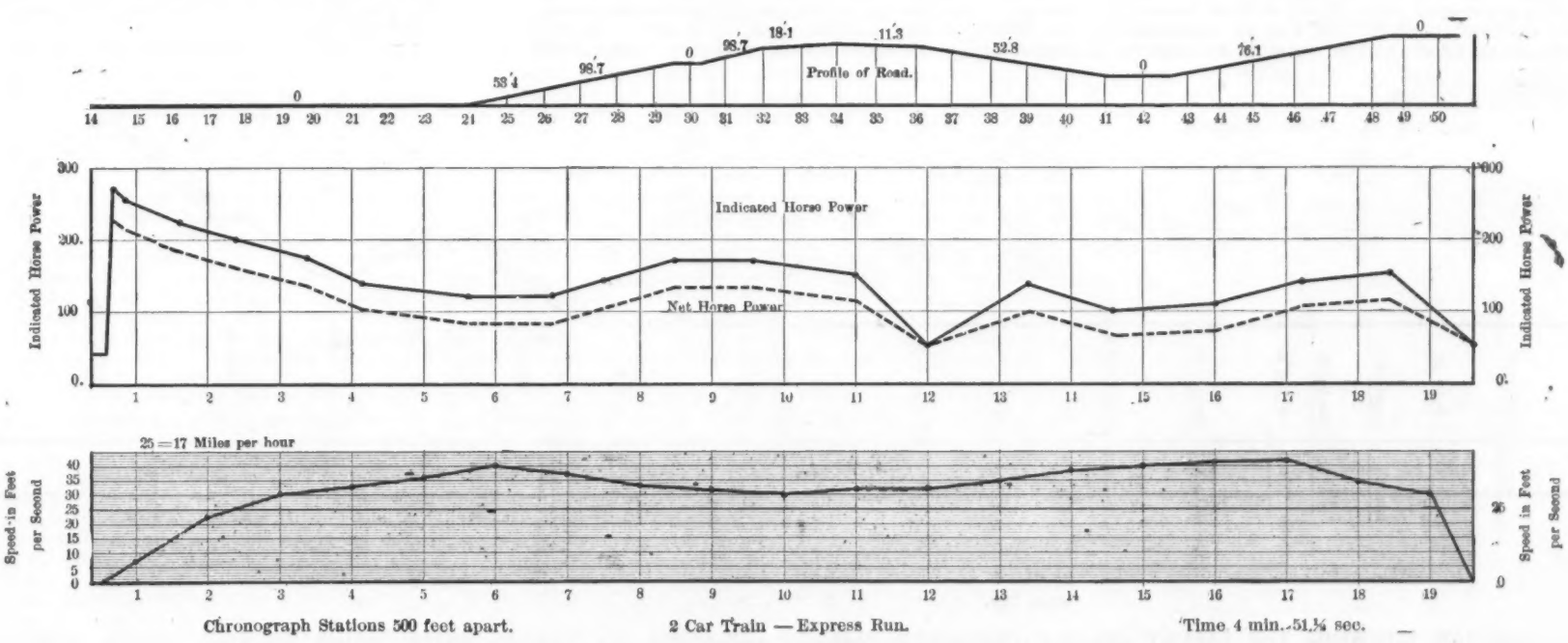

Profile of Road.
Indicated Horse Power
Net Horse Power
Indicated Horse Power
25 = 17 Miles per hour
Speed in Feet per Second
Chronograph Stations 500 feet apart.
2 Car Train — Express Run.
Time 4 min. 51¼ sec.

FIG. 2.—POWER TESTS ON THE NEW YORK ELEVATED ROADS.

To the mind of the mechanical engineer, having in view the ordinary coefficients of tractive ability, there is no remedy for this, but I think I shall be able to produce at least some little evidence that, owing to certain effects which have not yet been satisfactorily explained, an electric motor may be made capable of solving the problem at least so far as the ultimate strength of the present elevated structure will permit, inasmuch as the effects alluded to certainly do increase the tractive ability beyond that obtained by the use of any coefficients which may be found in the works of that eminent authority, D. K. Clark, or still later in the excellent treatise on the "Economic Theory of Railroad Location," by A. M. Wellington.

That these coefficients are not absolutely trustworthy is from any lubricant, are so rarely found in practice as to be scarcely worth taking into account in every-day work, it may fairly be considered as equal to three times the ultimate effort usually developed before slipping occurs.

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TRACTIVE EFFICIENCY OF ELECTRIC LOCOMOTIVES.

Reference has been made to the fact that the electric locomotive will draw a considerably heavier load than the steam locomotive of the same weight, and the suggestion is advanced that it is due to some electric condition of the rails and wheels, while I believe it has been clearly shown that certain things slide one upon the other much more freely when a current of electricity is passing from one to the other than when not. I do not know whether,

* Read before the American Institute of Electrical Engineers, New York, June 25, 1889.

in the case of the Ninth avenue cars, electricity passes from the wheels to the track, but if it does, the result is quite the reverse from the action assumed in the case of the locomotive wheels, and it does not seem at all necessary to refer the matter to any electrical or magnetic theory, as the mechanical conditions alone are such as to explain the apparent inconsistency, and in this way: The power of the electric motor is constant and the steam intermitten. If the steam locomotive has but a single cylinder, and the power required to draw the train be 700 pounds, the force exerted by the piston would be zero when the crank was at the dead centre, and 1,100 pounds at the maximum; so that while the electric motor doing the same work would exert only 700 pounds toward slipping the wheels, the steam locomotive with one cylinder would at times exert a force of 1,100 pounds. This assumption does not take into account the varying steam pressure nor the angularity of the connecting-rod, which, in certain positions, would make it more, nor the weight of the reciprocating parts and the inertia of the drivers, which would make it less, though, as slipping takes place in starting the train, the inertia would have but little influence.

It is true that the steam locomotives are not single cylindered, and at first sight it would seem that that makes a vast difference, and that with two cylinders the impulse is almost constant; but even assuming the steam pressure to be constant throughout the stroke, as was assumed with the single cylinder, the rotary effect of the two cylinders is not constant, and (unless I am badly mixed in my diagram) with a mean 1,400 pounds, or double the mean of the single cylinder, there will be a minimum of 1,100 pounds, and a maximum 1,571 pounds. This variation, together with the varying steam pressure on the piston, it would seem, is sufficient to account for the extra efficiency of the electric motor, if I am correct in my assumption that the limit in both cases is the slipping of the drivers.

I have dwelt longer on this branch of the subject than it might seem to warrant, for the reason that an eminent authority, in a paper read some three or four years ago, emphatically declined to admit this line of argument or the existence of this effect, and in strongly advocating a multiple motor system, declared that increased weight was the only possible means of increasing the tractive ability of the motors, and that to propose any other plan was simply to shut our eyes to plain mechanical and engineering truths. I am pleased to observe that in a later paper the truth of the effects which I discovered and strenuously insisted upon early in 1883 have been acknowledged by the same authority.

Referring to the plan of multiple motors where it was proposed to use one or two machines on each car, while there can be no question that the advantages are theoretically very marked in some directions, I think the multiplication of motive parts, necessarily much smaller and more liable to disarrangement than those on one machine of equivalent power, together with enormously increased first cost and cost of attendance and repairs, present practical disadvantages from which any railroad manager would naturally shrink; and, notwithstanding the able manner in which this plan has been presented and its obvious theoretical solution of a much vexed problem, I do not see any reason for changing my original plan; on the contrary, exhaustive experiments recently conducted lead me to the conclusion that the problem may be readily solved in another way.

Lest any misunderstanding should exist as to the object of this series of tests, permit me here to remind you that this motor was not expected to solve the problem by towing longer trains at higher speeds than are at present attained. It was simply for the purpose of proving that a machine weighing a little more than one-half the present motors would equal, or nearly equal, their performance in that respect, and while it must be admitted that in the matter of acceleration on the heavier gradients the steam-motors still show somewhat greater ability, the result of the test indisputably proves that, with motors of the same weight as those now employed, at least six-car trains on the Ninth avenue, and seven to eight car trains on the Sixth avenue, may be propelled at a considerably higher average speed than at present; and when the absence of reciprocating parts is taken into account, the advantage on the side of the electric motor, in lessening the destructive strain on the structure, will form an important factor in the economy of operation. That the absence of this destructive strain is no idle dream of the mechanical engineer has been fully realized by many competent observers of the electric trains, since it has been a subject of general remark that the noise of the electric train is merely that inseparable from the rolling of the wheels over the track, the motor itself making no more noise than one of the cars in tow.

I refer to these points, particularly because so many disappointments have been experienced by the public who seem to expect the electrical genii to wave his magic wand over the earth and cause all mechanical difficulties heretofore experienced to vanish in a moment, hence it is pleasant to be able to refer to the actual accomplishment of some of the most desirable advances in municipal rapid transit.

But the principal object is to show without fear or favor that it is now possible to run and compete with steam on the Ninth avenue railroad and, of course, any of the others with a certain concrete economy based upon a not permissible with such an arrangement, but a sufficient amount to prevent excessive hardness in working is obtained by placing alternating plates of rubber and iron in the pedestals above and below the bearings. A similar arrangement at the driver-bearings cushions the machine without interfering with the mesh to an appreciable degree. In fact, what little wear has so far been observed between pinions and gears shows remarkable uniformity of engagement.

Before the motor was placed in the cab it was deemed advisable to make a few Prony brake tests of its ultimate ability; it was therefore placed in the central station at Fifteenth street and a series of tests made resulting in the development of 128 h. p. A few higher readings than this were apparently taken, but as some little doubt was felt as to the accuracy of the observations, those were rejected and the above accepted as the ultimate reading.

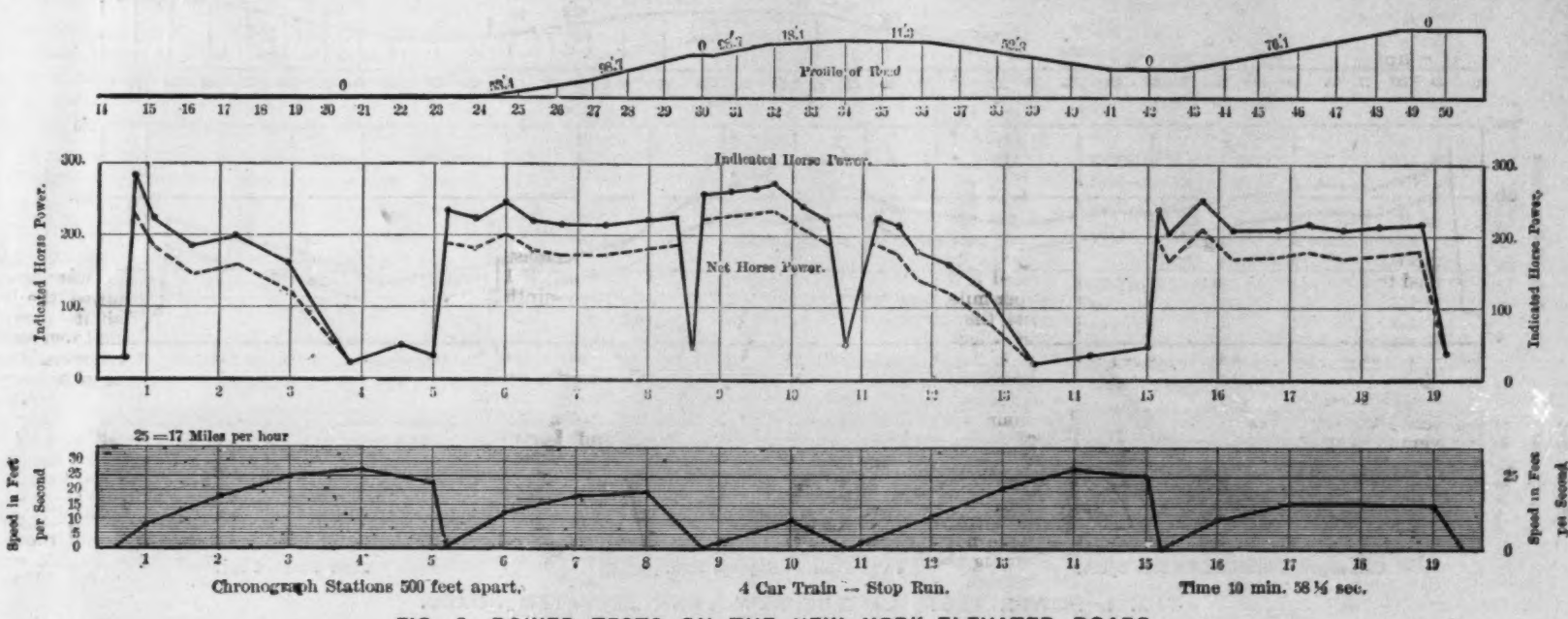


FIG. 3.—POWER TESTS ON THE NEW YORK ELEVATED ROADS.

The piece of track upon which the experiments have been conducted is eminently adapted for testing the tractive ability of a motor for this purpose, since there is only one piece of level track, 2,200 feet in length, the rest, embracing a distance of 1.846 miles, consisting of gradients varying between 11.3 and 98.7 feet per mile, and, in one instance, namely, at Thirtieth street, the start is made only a few feet from the bottom of a 98.7 foot gradient, thus testing the tractive capacity of the motor to the utmost.

In October last, experiments with this machine were begun on this piece of track, which through the courtesy of Col. Hain was placed at my disposal from 9 o'clock at night until 4 o'clock the next morning, and the first experiment consisted in taking a light load of one or two cars over the road to test the conductor and switch connections. This train was gradually increased night after night until one of eight Ninth Avenue cars, each weighing 12 tons, was towed over the entire road, going up the 98.7 foot grade at a speed of 7½ miles per hour and making the entire distance in 7 minutes 35 seconds, or an average speed of 14 6 miles per hour. Although a drizzling rain prevailed and the rails were slippery, there was an entire absence of slipping.

I regret that at the time of this experiment we were not using the dynamometer, but taking the ordinary coefficient of rolling friction for a light train of this kind, namely, .004, and assuming that the grade resistance to be at the same rate per cent. of the total weight of the train as the rate per cent. of the grade, and the rate per cent. of the grade being 1.86, we get the following:

$$\frac{1.86 \times 4781 \times 660}{33000} = 95.8 \text{ h. p.},$$

to which should be added at least 15 per cent. for friction and a so-called "head resistance" of the motor, equaling 14.37 h. p., or a total of 110.17 h. p. at Fifteenth street.

The maximum velocity obtained by that train on the level in passing Twenty-third street was 24 feet per second or 16.36 miles per hour.

These tests were continued for several weeks at intervals of two or three nights, during which time a great number of experiments were tried as to the ability of the motor to make the switches, start on gradients, etc. And I am able to state as a simple matter of record that

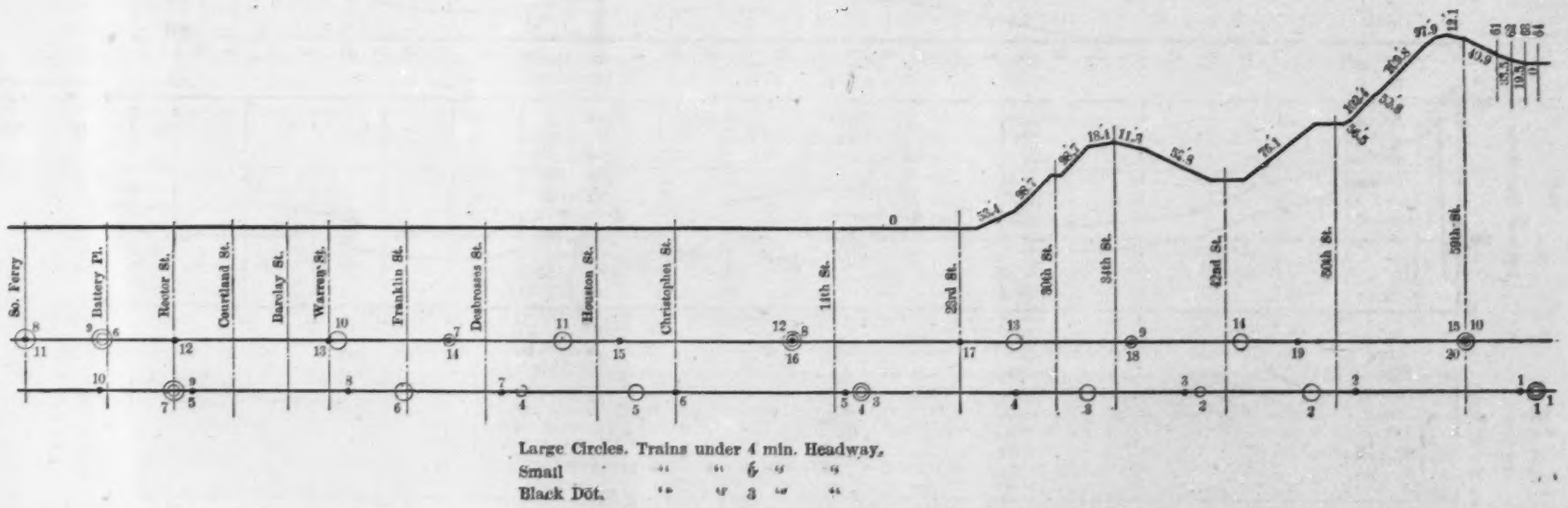


FIG. 4.—DIAGRAM SHOWING THE EFFECT ON H. P. REQUIRED, DUE TO LOCATION OF GRADES WITH TRAINS UNDER VARYING HEADWAYS.

though the tests were of the most exacting character, absolutely the only repairs or delay during all this time and subsequent tests were two, once when a spool had to be removed from developing a contact, which caused a delay of one night, and the other time when a moving axle wore a hole through the insulation of an end spool and caused a detention of fifteen minutes. With these two exceptions the motor has been ready to run at any moment during the whole time in spite of the roughest treatment, and being left on the track exposed to the weather for months past.

I think I am entitled to say that these results which were, of course, carefully watched by the Manhattan railway officials, led to our obtaining permission to run in the day time between steam trains—a permission which you may be sure would not have been granted on a road which has a world-wide reputation for its almost military discipline and precision of management, if the motor had not earned the right to some confidence. On the 28th day of Jan., 1889, we began running between the hours of 11 and 2 in the day time, which was continued with a three-car and occasionally a four-car train, running express, until the 12th day of February, when we requested to take a train of flat cars loaded with iron to the weight of an average four-car train with seventy-five to one hundred passengers, in lieu of the light train formerly employed. With this train, weighing in all 70 tons, I made several trips over the road between the ordinary steam trains, but finding the brakes hardly trustworthy enough for such critical work, with trains only three minutes from us on either side, it was decided to discontinue this service, and a four-car Sixth avenue train was substituted. With this train several trips were made, but in consequence of the absence of air brakes it was not considered advisable to proceed with the ordinary "stop run," and the remainder of the work was done at night; but I may say that during this period of thirty days, with one exception above noted, not the slightest detention was caused by the regular trains, as we were always able to switch on to the track, make our trip, and get back on to the switch at Fiftieth street without interfering with the steam trains in the least.

A number of experiments made about this time show that the mean speed, with a three car empty train, running express, on the up-town track, was about 28 miles per hour, though on the level the ability of the motor, with a similar train, is nearly 28 miles per hour. This is by no means the limit of speed which the motor is capable of attaining, for, as will be seen by reference to diagram Fig. 1, the work of acceleration was still in progress when the gradient at Twenty-fourth street was encountered; hence it seems perfectly fair to assume that, even with that 40 ton train, the maximum level speed is not shown. With a lighter load the speed would undoubtedly be much greater, but for prudential reasons it was not deemed well to push this matter of speed to its extreme limit, especially in view of the fact that the machine was not designed for a speed of over 25 miles per hour, and any derangement resulting from excessive peripheral armature speed might have prevented my ability to present a clean record to-night.

To any one traveling on a structure similar to the Ninth Avenue Elevated Road at a speed of 28 miles per hour, particularly at night, and at an altitude of 30 feet, seems to be sufficient for all practical purposes; and I must confess that in driving the motor at that speed under these conditions I was conscious of a marked absence of any desire to greatly increase it, neither does it seem to be necessary that greater speeds than 30 miles per hour should be attained in the city limits (by express trains) to meet all the proper requirements of rapid transit; and when the great power which experiment shows to be required for the accelerative effort between the frequent stations and with the comparatively heavy trains on the Sixth and Third avenues are taken into account, it is extremely improbable if this speed will ever be exceeded between stations on these structures.

Referring to the methods adopted in making the measurement which are plotted in the diagrams, it should be noted that wherever any doubt existed as to the effect of the personal equation in the observations, changes were made in the observers, and the experiments repeated so as to leave scarcely a possibility of any material error; and in order that the always objectionable average statement should not contribute to confuse the result, the diagrams were taken from a number of similar ones, which, after careful examination, were found to most fairly represent the mean effects. They are therefore within the limits of error in observation, the exact results of actual performance.

In order to measure the speeds with sufficient accuracy for all practical purposes, I divided the track into nineteen sections of 500 feet, each section being provided with a thin copper plate attached to the guard rail at the side of the track and connected with a copper rod or insulated side of the conductive system. This plate was made as short as possible to insure a complete contact without occupying an appreciable interval. A copper brush attached to the motor in such a manner as to travel on the top of the guard rail was connected with one terminal of a chronograph of the well-known type, which we made for this purpose, consisting of a paper-covered cylinder rotated at a uniform speed by clock-work, and a stylus actuated by an electro-magnet so as to penetrate the paper at every closure of the circuit. This instrument was carefully tested and the results verified by experiments before the readings were accepted. The indicator cards were taken at the central station by Mr. Idell and his assistants, after a careful comparison of watches so as to insure synchronism in observing the effects of accelerations and gradients. The dynamometer used was a very fine specimen of the liquid type owned by the Manhattan Railway, and made by Mr. Shaw, of Philadelphia, and after careful calibration by Mr. Shaw and Mr. Idell was found to be accurate within an inappreciable amount. The dynamometric readings I have omitted from these observations, for the reason that they were found to throw so much light upon the ordinarily accepted coefficients of train resistance, under many of the conditions which the text books have not yet considered, and especially the formulas relating to the subject of acceleration, that time would not permit a thorough digest of the results; hence it was deemed better to leave this part of the subject for later consideration; and I trust you will shortly hear from Mr. Idell on this subject in his usually able and thorough manner.

Referring to the diagram Fig. 1, representing the run of a two-car express train having a total weight of 40 tons, it will be seen that the initial indicator card is exceedingly high as compared with the apparent effort required. The reason for this is that our plan in taking the cards was to make the first one at the instant of closing the circuit, thus giving a card due to the simple dead resistance of the motor which, with a ratio of peripheral velocities necessary for this work and a speed of 30 miles per hour, would necessarily be low and occupy at least a few seconds in developing an economic working resistance, unless a somewhat complicated arrangement was resorted to. But this point will be later referred to.

Following the speed line it will be seen, as might be expected, since we see that the accelerative effort is rapidly diminishing towards the foot of the gradient, that the indicator cards become a minimum at the maximum velocity of the train, but quickly rise beyond Twenty-seventh street, where the gradient is 98.7 feet per mile. The effect, however, of acquired momentum is here very evident, since neither the indicator cards nor the declining velocity are at all proportional to the resistance imposed by the gradient, and the speed of the train varies but little from this point to Forty-sixth street, being only slightly increased on the down grade between Thirty-fourth and Forty-second streets, due to a change in the combination for the purpose of checking what would otherwise have been too great speed for safety. The dip in the indicator line between Thirty-sixth and Thirty-seventh streets is occasioned by the cards having been taken at the instant of the change in combination; at Forty-sixth street the decrease of speed is the result of encountering the gradient, 76.1 feet per mile, and between Forty-eighth and Forty-ninth streets the circuit was opened for the stop at Fiftieth street, when, as will be seen, the indicator line quickly drops to the friction card only. This run of 1.846 miles was made in 4 minutes and 51½ seconds, as recorded by the chronograph. This is at the mean speed of 22.84 miles per hour, with a maximum of 2[illegible].4 miles per hour indicated on the up-grade between Forty-fourth and Forty-sixth streets. The speed in passing Twenty-third street, the end of the level stretch, was 28 miles per hour.

The mean power exerted at the central station for propulsion during this trip was 103 horse-power, which will campare not unfavorably with steam practice.

Turning to diagram Fig. 2, representing a four-car express train, having a total weight of 70 tons, or about the average weight of a four-car loaded Ninth avenue train, we are confronted with the curious fact that the initial indicator card is lower than that shown with the two-car train; but a careful examination of the two diagrams will show that the card was taken a few seconds after the start, and not, as in the case of the two-car train, at the instant of closing the circuit. The effect, therefore, of the rapid development of working resistance is very clearly shown, and is a most important factor in considering the high initial cards, since they are of only an instant's duration, and hence comparatively unimportant in their effect upon the total power required to run a considerable number of trains at one time. In this run the characteristics of the two-car run are very nearly reproduced, though it is particularly noticeable that the indicator line does not show so large an increase as one might at first thought expect from doubling the number of cars; but this is accounted for by the greater ratio which the friction and load of the motor presents to the two-car train.

The total time of the trip with this train consisting of 4 Sixth Avenue cars, each weighing 15 tons, plus the motor, weighing 10 tons, was six minutes and six seconds, with a mean speed of 18.15 miles per hour and with a maximum speed of 25.24 miles per hour between Forty-second and Forty-third streets, which is, however, almost equal between Twenty-fourth and Twenty-fifth streets when, as above noted, acceleration was still in progress. The mean power exerted at the central station on this run was 129.3, resulting from 91 ordinate readings. This result was almost exactly the same as the running time of the express steam trains of equal weights over the same distance, and may be repeated at any time.

Comparing the two former with diagram Fig. 3, representing a four-car "stop-run," several of which were made chiefly for the purpose of demonstrating the ability of so light a motor to stop at the foot of a gradient of 98.7 feet per mile, as at Thirtieth street, with a train of 70 tons, and ascend the gradient from a position of absolute rest with ease. These "stop runs" with this train were made many times without encountering any difficulty whatever, and at no time during the whole tests has the motor shown indications of over-load. That the four car "stop-runs" were not made in schedule time will be seen by the diagram, but a careful inspection of the same will show the exceedingly prejudicial effect of the absence of an efficient brake system, compelling the opening of the circuit two or three blocks before the station is reached in order to insure a proper stop at the platform. This is graphically shown on the indicator line of the diagram where the circuit is seen to be open at Nineteenth street for the stop at Twenty-third, thus considerably lowering the speed and of course stopping the rapid acceleration shown on the speed line at the third chronograph station. This disadvantage was so marked that I do not present the four-car "stop-run" as evidence of anything but the ability of the motor heavily loaded to ascend the gradients under the exacting conditions of an exceedingly difficult piece of track.

That there is not a marked difference between the 10-ton motor and the 18-ton locomotive in the initial effort on the level may be seen by comparing a run observed by a Manhattan railroad official, on March 9 last, with a steam motor and three-car train, with 75 passengers, or a total of about 57½ tons. We see that while the steam motor required 1 minute and 39 seconds to make the distance from Fourteenth to Twenty-third streets, the electric motor in diagram No. 3 accomplished the trip, with a train weighing 14 tons more, in 1 minute and 50 seconds, or only 11 seconds added for the increased 14 tons; surely not a discouraging exhibit, when the fact that while the absence of powerful brakes compelled the opening of the circuit at Nineteenth street, the throttle of the steam motor was probably open up to Twenty-second street—although on this point I have no direct evidence, but that is the usual practice.

Before dismissing this diagram, I will again remark that while the mean speed was not equal to the ordinary schedule of the Ninth avenue road, it is nearly equal to that of the Third avenue, with 22-ton motors and 80-ton trains. In considering the apparent mean expenditure of power at the central station, it should be borne in mind that the effort exerted by these motors on such rapidly varying gradients, and over such short distances, on the elevated railroads are not by any means represented by the ordinary coefficients of train resistance and effect of gravity, as it has been before pointed out very clearly by others that, while the up grades always exert their full effect, the advantage generally obtained from down grades on long runs by acquired momentum is here nearly always lost by the position of the gradients with reference to the stops. It has been shown by Messrs. Sinclair and Campbell that on the Third avenue road, with the 30-ton trains and 22 ton motors, 170 horse-power is not infrequently exerted; hence to consider this problem merely by the ordinary coefficients of rolling friction and gravity resistance would, and does, frequently lead to very serious errors in computing the amount of power actually used on short railroads, with frequent stops.

However, it is not my purpose to enter into the niceties of train resistance, since the best authorities differ widely on these points, and theoretical economics form no part of the present subject. But, as I think I am presenting to you for the first time a critical examination of actual competition with steam motors on steam roads in the work of towing entire trains, I trust you will not fail to recognize that electricity is at last measured and weighed against its most formidable opponent in railway practice.

For many years the electric motor struggled hard to prove its ability to compete with even the most costly competitors, namely, manual labor, and even here the introduction of the dynamo machine was necessary to achieve the victory; then quickly followed the long competitive battle with horses, in which it is evident the equine has been signally defeated; and to wrest a victory from the steam locomotive in its own domain is quite another matter; but I think you will agree with me that proof of a large economy in the vital item of fuel under decidedly adverse circumstances may be so construed without dangerous optimism, and the result of all these tests has seemed to prove that the measurements might be laid bare without in the least shaking the confidence of competent judges in the ability of the electric motor to replace steam for service, at least as severe as that of the elevated railroad systems; and in amplification of the results obtained, we have here a diagram, Fig. 4, graphically representing the present service of the Ninth avenue elevated road, where the position and number of trains for all hours of the day are plotted and the actual horse-power required, as shown by the indicator cards.

NO. I.

Ten three-car trains, to be run under six-minute headway, between Fifty-ninth street and South Ferry.

Train No.	Location.	Horse-power required.
10	Starting at Fifty-ninth street	200
9	Up grade to Thirty-fourth street	150
8	Running on level	130
7	" "	130
6	Starting at Battery Place	190
5	" Rector street	190
4	Running on level	130
3	" "	130
2	Down grade to Forty-second street	...
1	On switch at Fifty-ninth street	...
		1,250
	Add 10 per cent. for contingencies	125
	Total horse-power	1,375

Estimated amount of power required to equip, electrically, the Ninth Avenue Division of the Manhattan Elevated Railway.

Ten four-car trains, to be run under six-minute headway, between Fifty-ninth street and South Ferry.

Train No.	Location.	Horse-power required.
10	Starting at Fifty-ninth street	200
9	Up 52 foot grade to Thirty-fourth street	200
8	Running on level	150
7	" " "	150
6	Starting at Battery Place	200
5	" " Rector street	200
4	Running on level	150
3	" " "	150
2	Down grade (52 feet) to Forty-second street	...
1	" " into switch, Fifty-ninth street	...
		1,400
	Add 10 per cent. for contingencies	140
	Total horse-power	1,540

Fifteen four-car trains, to be run under four-minute headway, between Fifty-ninth street and South Ferry. Location of trains when train No. 15 has been run underway two minutes.

This gives larger results than when train No. 15 is starting from Fifty-ninth street.

Train No.	Location.	Horse-power required.
15	Down 105-foot grade to Fiftieth street	...
14	Up 52-foot grade to Thirty-fourth street	200
13	Running on level	150
12	Starting at Christopher street	200
11	Running on level	150
10	Starting at Cortlandt street	200
9	" " South Ferry	200
8	" " Battery Place	200
7	" " Barclay street	200
6	Running on level	150
5	" " "	150
4	Up grade from Twenty-third street to Thirtieth street	200
3	Down grade to Forty-second street	...
2	Up 105-foot grade to Fifty-ninth street	250
1	On switch	...
		2,250
	Add 10 per cent. for contingencies	225
	Total horse-power	2,475

Twenty four-car trains, to be run under three-minute headway, between Fifty-ninth street and South Ferry. Advancing trains one minute from start.

Train No.	Location.	Horse-power required.
20	Down grade to Fiftieth street	...
19	" " " Forty-second street	...
18	" " " Thirtieth street	...
17	Running on level	150
16	" "	150
15	" "	150
14	Starting at Franklin street	200
13	" " Barclay street	200
12	" " Battery place	200
11	Running on level	150
10	Starting at Rector street	200
9	Running on level	150
8	Starting at Warren street	200
7	Running on level	150
6	" "	150
5	" "	150
4	Starting at Thirtieth street	220
3	" " Forty-second street	200
2	Up grade to Fifty-ninth street	250
1	On switch at Fifty-ninth street	...
		2,870
	Add 10 per cent. for contingencies	287
	Total horse-power	3,157

RÉSUMÉ,
And to obtain the average for the day.

Train No.	Cars on train.	Head-way.	Time.	Time in service.	H. P.	H. P. hours.
			A. M. to A. M.	hr. min.		
10.....	4	6 min.	5 09 to 6 03	0 54	1,540	800
20.....	4	4 "	6 03 to 6 15	0 12	3,157	631
21.....	4	3 "	6 15 to 7 00	0 45	3,157	2,367
20.....	4	4 "	7 00 to 7 24	0 24	3,157	1,315
21.....	4	3 "	7 24 to 7 41	0 17	3 157	1,052
20.....	4	4 "	7 41 to 9 03	1 22	3,157	4,209
			P. M.			
10.....	3	6 "	9 03 to 4 15	7 12	1,375	9,900
			P. M.			
20.....	4	4 "	4 15 to 5 07	0 52	3,157	2,735
22.....	4	3 "	5 07 to 5 53	0 46	3,157	2,420
20.....	4	4 "	5 53 to 6 13	0 20	3,157	631
10.....	4	6 "	6 13 to 9 00	2 47	1,540	2,880
				15 51		29,940

Average h. p. per hour $\frac{29,940}{16} = 1,871$ h. p.

To which must be added the power consumed in engine and dynamo friction and loss in line.

	1,871
Station friction.....	300
	2,171 h. p.

Evap., 7. 5 water for 1 pound coal.
Hence coal consumption,
$2,171 \times 16 \times 2.2 = 38 + 3$ tons for banking, = 41 tons.
at $2.24, = $92.25 per day.

From this table it will be seen that for five hours out of the sixteen of daily service 2,870 h. p. would be required, or, adding 10 per cent. for contingencies, 3,157 h. p., during these times when 20 and 21 four-car trains would be in operation under 3 minutes headway, being reduced to 1,250 h. p.; or, adding 10 per cent. for contingencies, 1,375 h. p., for the seven hours and twelve minutes intervening between 9.03 A. M. and 4.15 P. M., when ten trains of three cars are in service under 6 minutes' headway, while during 54 minutes of the early morning, between 5.09 A. M. and 6.03 A. M., and the late evening service of two hours and forty-seven minutes, between 6.13 P. M. and 9 P. M., in which case 10 four-car trains are in service, 1,400 h. p. would be required, or, again, adding 10 per cent., 1,540 h. p.

It should be remarked that the power indicated for this service might be very advantageously divided up into four engines of 800 h. p. each, as an examination of the traffic table will show that for only five hours per diem the whole of them would be required, and during the long period of seven hours and twelve minutes, between 9.03 A. M. and 4.15 P. M., two of the engines would be ample for the service

The results are, however, plotted and show that the total energy per diem equals 29,940 horse-power hours, or, divided by 16, the number of hours of service, 1,871 h. p per hour, and adding 300 h. p. for dynamo and engine friction, the total should be 2,171 h. p. per hour, which at 2.2 pounds of coal per horse power per hour equals 38 tons of fuel consumed per diem, and adding 3 tons for banking the fires equals 41 tons at $2.25 per net ton, or a total of $92 25 per diem for fuel alone.

In this connection I should mention that the coal here referred to is a mixture which may be obtained at the dock in New York for about $1.80 per ton, and which is shown by Barrus, in his work entitled "Boiler Tests," to be capable of evaporating 7½ pounds of water per pound in a properly constructed furnace.

There are several makers of compound engines in this country who will guarantee the performance of their engines on 16 pounds of steam per horse-power per hour. It is thus evident that the amount of coal above referred to is a safe one for modern practice on so large a scale. The present locomotives on the Ninth avenue require an average of 40 tons of coal per day for motive power and braking, but experience has shown that it is economical in small locomotive practice to use coal of the best quality, hence the cost of this 40 tons of coal is $200 per day, or more than double the cost of that for the electric motive system.

It is of course necessary to add to the electric estimate a number of charges, such as wages of firemen and engineers at the central station, which would probably bring this item up to about $150 per diem, considering other items balanced by their practical equivalent in the present service and the cost of repairs, depreciation, etc., to be about equal, which is not far from the fact.

It is thus evident that without considering the future obvious advantages which must necessarily accrue from the use of a great central station equipped with dynamos, as before stated, and a conductive system ample for all requirements of the road that with the comparatively wasteful central station arrangement we have here considered involving the use of small dynamos of a very old type placed at the extreme end of the conductive system, and suffering from many incidental disadvantages, that it is possible to run the Ninth Avenue Elevated road with electric motors at an actual and considerable saving of fuel to-day; and if this is not the only example of such a practical demonstration, as opposed to direct steam propulsion, it is at least the first I have been able to find on record.

The experience of these extended tests and almost innumerable indicator cards, together with countless observations which have been made during the past eight months, have naturally borne fruit in eliminating many objectionable features which only such an examination could develop, and though, as has been said, it is no part of the object of this paper to treat with other than actually accomplished work, it seems but proper to add that the experience gained in this direction has been embodied in another motor, now nearly complete, capable of not only doing such work as is at present accomplished, but of solving, at least for the near future, the vexed problem of extended traffic for the elevated railroads; and though no actual tests of it have been made, there can be little doubt, judging from the performance of the present machine, that it will be capable of towing at least a six-car train on the Ninth avenue elevated road with a considerably increased average speed and with a comparatively low initial effort, due to a change in the proportions of parts and manner of winding, to meet the peculiar conditions shown in the diagrams.

In this arrangement the braking of the motor and train has been electrically provided for, also, of course, the lighting; but as this machine is not actually finished I will not further refer to it other than to call your attention to a part of the proposed plan, namely, the conductor, a section of which has already been placed on the Ninth avenue elevated road at the curve below Fourteenth street.

There are also economies of braking and in the manipulation of the train, to which I cannot at present further allude, which would, however, in all probability, considerably reduce the working expenses. In this motor, the experience which we have had in handling has led to great simplification of the regulating and reversing gear, so that one man may handle the train without the least assistance.

That the plan first suggested by the late Sir William Siemens of braking the trains by converting the motor into a dynamo and so returning a part of the stored up energy of the train to the conductive system would result in considerable economy, there can be no doubt, provided a thoroughly satisfactory method of practical application were applied; but it is an item that does not appear very conspicuously in any of the quantitative examinations which I have yet seen of any electric syst.

while I do not wish to be understood as lightly estimating such an obvious economy before accepting it as so important a factor, as its theoretical consideration by some electricians would indicate, I should like to see at least a few carefully digested observations of actual performance with motors of high powers.

In conclusion, I trust that if the foregoing facts are not accepted as conclusive proof that the problem is already solved that they may at least furnish a sufficient amount of tangible material to assist in the early and complete accomplishment of our most sanguine hopes.

What Shall We do With Our Watches?

To the Editors of The Electrical World:

We are told that electricity and magnetism ruins the watch, and as time is such an important factor in this rapidly-moving age, there arises the serious question of What shall we do with our watches? In the operation of railways we must have *correct* and *reliable* time in the pockets of our employés, and as electrical appliances are invading all parts of train service, thus rapidly increasing the dangers surrounding trainmen's watches, now, which way shall we turn for relief? In the late electrical exhibition in Chicago I noticed the exhibits of the "Non-Magnetic Watch" companies and the "Anti-Magnetic Shield for Watches," and on inquiring among them for information have got about this—each of the non-magnetic watch companies says about as follows of the others: "Their watch is not permanently adjustable;" "it will not hold its rating;" "they do not possess the secret of making alloys of metals from which they can make a good, adjustable, non-magnetic watch;" "*we* have the only true non-magnetic metal from which the watch can be made which possesses permanent time-keeping qualities;" "the anti-magnetic shield is not good for much;" or, "it is only a partial protection," etc., etc. I passed over to the "Anti Magnetic Shield" exhibit, and was told there that "the shield will protect the watch from all magnetic influences to which the wearer would be subjected in any avocation," and "that the shield enables us to use the regular '*steel and brass escapement*' which has been proved to be the only permanently reliable material to be used in the construction of a watch, by the last fifty years' experience and experiments;" also, that "by the use of the shield, permanent conditions are created around the watch, and it thus utilizes magnetism to improve the rate of the watch, and in this way a better rate is obtained from any watch, under any and all conditions, than could otherwise be obtained;" and further, "that the protection is *permanent and positive*." Next, I go among expert watchmakers and find expressions and opinions divided. Some say "it is a scientific impossibility to substitute soft or 'non-magnetic metal' for steel in the watch, and get a permanently good rate from it;" "it may run well for a time, but will 'all go to pieces' sooner or later." Others say: "I think that they have now got a non-magnetic watch which will keep time, but it has not been long enough in use yet to prove it." "Some say of the Anti-Magnetic Shield: "It is of little practical use, and does not prove a full protection for the watch;" "magnetism is a mysterious force, and can never be controlled, and any one who says he can control it is a 'fraud,'" etc. Others say: "The shield is a perfect practical protection, and of great advantage to the watch," and "no watch should be carried without it;" "it is one of the greatest inventions of the age for watch protection," etc. Now, as "doctors disagree" in the watch trade, I turn to you for information on some points which come directly in your line, viz., electricity and magnetism, and if not asking too much, would like you to give us some facts in this matter by answering the following questions:

First. Does magnetism ruin a watch, or does it permanently injure its performance?

Second. Does the "Anti-Magnetic Shield" protect the watch from magnetism?

Third. If so, how does it do it? That is, on what scientific principle does it accomplish its mission?

Fourth. Does it protect fully, or how strong a magnetic influence will it withstand in actual use among railway employés and electricians?

Fifth. Are its powers of protection permanent?

Sixth. Is there anything in its nature to injure a watch?

Seventh. Or, on the other hand, is there anything in it to improve the rate of a watch?

It appears on the face of the evidence that *if* the "Anti-Magnetic Shield" does *protect* the watch, it is what we want, for it permits of the manufacture and use of what has been proven to be permanently *good* in the construction of a watch. When there is so much at stake, as in railway service, we cannot afford to take "chances" on the "uncertain," and life is too short to experiment with what it takes years to prove. Let this generation prove by experiment, and then the next can enjoy it.

Reliable answers to the above will clear away many cloudy points in the minds of some watch owners, and will be appreciated by none more than the undersigned.

NEW YORK CITY. RAILWAY.

Dr. Otto A. Moses having recently made some tests bearing on the above questions, the letter was submitted to him and has elicited the following statement:

The communication signed "Railway," which you sent me to read, contains seven questions which you wish me to answer. I refer to them in the order in which they are asked.

1. "Does magnetism ruin a watch, or does it permanently injure its performance?"

The object in making a watch is to obtain a uniform time indicator going at regular speed. If any or all parts of a watch be magnetized and move in different times and directions, they will attract each other with differing force at different times, and so interfere with each other's regular periodic motion. This variable motion during any given time, say twenty-four hours, may, however, be made to synchronize with other and similar time periods; that is to say, a magnetized watch may be approximatively regulated, so as to gain or lose at a certain rate for every twenty-four hours, provided the watch is not brought into any other field of electric force than that it bears about with it.

2. "Does the anti-magnetic shield protect the watch from magnetism?"

It does provided the steel parts of the watch are not —zed when introduced into the iron case. The principle governing this action may be illustrated by the following (I believe) novel experiment:

Introduce into an iron pan, half filled with water, about one foot in diameter, and three or four inches deep, a magnetized and an unmagnetized sewing needle. Keep the needles so far apart that the unmagnetized one is not apparently affected by the other; but do not let either touch the pan. Then approach a bar or other form of magnet to this arrangement in a horizontal plane, which is below the top edge of the pan. The magnetized needle will be vigorously affected in spite of the iron shield, but the unmagnetized needle will not move; and this is the case even if the arrangement is brought into a most powerful field of force, say within a foot distance of the pole pieces of an Edison 100 ampère dynamo machine.

This paradoxical action may be thus explained: Every permanent magnet can be considered as an independent source of power whose lines of force have a tendency to shorten and to occupy iron. In the experiment, the magnetized needle will place itself in a resultant direction, determined by the mass of the iron pan which surrounds it. The unmagnetized needle is not affected by the iron of the pan. Now, on a movement of translation being given to the exterior bar magnet, its lines of force will also shorten and occupy their share of the neighboring iron, and will cut those of the interior magnetized needle, and in doing so will produce a corresponding reaction on the latter, causing it to set in a new resultant position. But still no effect is observed on the unmagnetized needle.

Hence, it may be concluded that if the works of a watch which contain unmagnetized steel parts are inserted in an iron shield, the magnetizing influence of an exterior field of force will not produce magnetism in the interior unmagnetized parts.

Questions 3, 4, 5 and 6 are answered in this experiment.

Seventh. "Is there anything in it (magnetism) to improve the rate of a watch?"

I have made a series of observations on the rates of several movements protected by the watch cases of the Giles Anti-magnetic Shield Company, kindly loaned for experiment, and I have noted a remarkable steadying influence on the rate of watches surrounded by an iron shield when introduced and kept for many hours in a very powerful and constant magnetic field; in fact, the quality of the above watches (which were not costly) seemed vastly improved by this treatment, as under it they became more regular and better time-keepers.

These answers, I hope, will meet your requirements, and, perhaps, those of your correspondent "Railway."

We have also been favored with the following comments from Mr. C. K. Giles, of Chicago:

First.—It is a fact, known for years, that magnetism destroys the reliability of the watch as a timekeeper; the effect of magnetism is uncertain—it may cause the watch to lose, or gain time, or stop altogether, but nothing regular; it may run right for an hour, or half a day, a day, or a week, and the next hour may show several minutes off time. A watch may be demagnetized, and restored to its usefulness, but it is always subject to the same dangers.

Second.—It must be accepted as true, that the "Anti-Magnetic Shield" will protect the watch from magnetism—this has been proven by the practical experience of so many electricians and others, in actual service, that the fact of protection is beyond a doubt.

Third.—The principle involved in this protection is the one of the "closed magnet circuit," the shield being made of highly magnetic metal, in a complete circle, and the circle being formed into a *cup*, by the cap on one end, all the space within this *cup* is held in a neutral condition, or state of equilibrium, or in a state of "satisfied polarity"—that is, the influence, bearing on the space enclosed in the shield cup is the same from every individual molecule (or every theoretical point) in the circle of the shield. Therefore, being an equal force from every point towards the centre, it has *no effect*, or rather, the result is the same as in the neutral point of a bar or horse-shoe magnet. This neutral point is made so by the fact that the positive and negative force (or two poles) meet at this point, and one "force" or "pole" just equalizes the other, which results in a "state of equilibrium" at this meeting point, and, as a matter of fact, this "neutral point" is "corralled" within the circle of this "shield metal." Faraday demonstrated the absence of magnetic effect in such an enclosed space many years ago; therefore, the knowledge of the principle of this operation is not new.

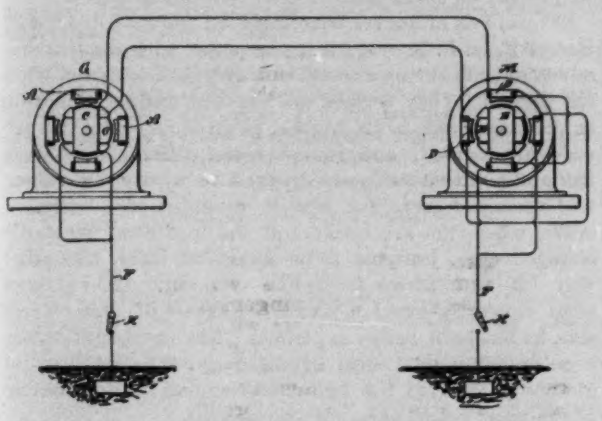
Fourth.—As to the amount of magnetic force the shield will withstand, it depends upon the conditions. It is obvious that as the shield is made of highly magnetic metal, when it is placed directly in contact with a magnet or a dynamo, it ceases to be a "shield"—it is then but a part of the magnet, or a part of the dynamo. If the shield is kept from metallic contact with the active magnet it is then in a "magnetic field," and will naturally form its own magnetic centre, and the shield circle or cup will form of itself a closed magnetic circuit, within which is the point of protection for the watch movement. Therefore, I should say, if kept from immediate contact with magnets and dynamos the shield will withstand any force, or any set of conditions which the wearer could be reasonably supposed to be subjected to. It is also an obvious fact, that from the principle of this protection (*i. e.*, the closed magnetic circuit) the resistance of the shield will be increased in proportion to the force applied (or the intensity of the magnetic field); that is, the more force there is applied to this closed magnetic circuit, the greater the intensity in the molecules of metals forming the circle itself, hence the greater the resistance to any force approaching from the outside, while the space within will still be held in a state

of equilibrium, and this circle of equilibrium will only be destroyed when force enough is brought to bear to destroy the individuality of the magnetic centre formed by the shield cup, which would require an extraordinarily strong set of conditions.

Fifth.—The protective power must necessarily be permanent, as the metal from which the shield is made is naturally magnetic, therefore must last as long as the metal itself.

Sixth.—There can be nothing in the shield to injure the watch, as its influence is *passive*, not *aggressive*, and cannot interfere with the mechanism of the watch.

Seventh.—On the other hand, its tendency would be naturally and scientifically to improve the rate of the watch, by surrounding the movement with a set of permanent conditions, and protecting it from the charging magnetic and electric conditions which a watch in use would be necessarily passing through every day. The electric currents injure a watch by the magnetic conditions which electricity always causes. The shield should "steady" the rate of the watch for these reasons, viz., every piece of steel in the watch is naturally magnetic, and has a magnetic field around it, and when a watch movement is placed within the shield circle, this magnetic field surrounding each piece of steel is not destroyed or *annihilated*, but immediately adapts itself to the new set of conditions, or a new equilibrium is established between the watch movement and the shield, and the vibrating parts of a watch have a permanent field of equilibrium to move in, which is an obvious benefit, and should result in a steadier and closer rate for the watch.



TESLA SELF-STARTING ALTERNATING MOTOR.

The Tesla Self-Starting Alternating Motor System.

As is well known, certain forms of alternating current machines have the property, when connected in circuit with an alternating current generator, of running as a motor in synchronism therewith; but, while the alternating current will run the motor after it has attained a rate of speed synchronous with that of the generator, it will not start it; hence, where these "synchronizing motors," as they are termed, have been run, some means have been employed to bring the motors up to synchronism with the generator before the alternating current of the generator is applied to drive them. In some instances mechanical appliances have been utilized for this purpose. In others, special forms of motor have been constructed.

With the object of effecting the starting of the alternating motor and bringing it to synchronism without external aid, Mr. Nikola Tesla has devised a simple system in which he employs an earth return during the period of starting only. For this purpose he constructs a generator with two coils or sets of coils and a motor with corresponding energizing coils or sets of coils. By means of two line-wires, one terminal of each generator coil is connected to one terminal of its corresponding motor-coil while the opposite terminals of the generator-coils are joined together, and likewise those of the motor.

To start the motor an electrical connection is temporarily established between the points of connection between the coils in the generator and those in the motor, so that the system becomes an ordinary double-circuit system. When by this plan of connection the motor has attained the desired speed, the earth connection is severed, by which means the system becomes an ordinary single-circuit synchronizing system. The accompanying diagram shows the manner in which this is accomplished, *G* representing an ordinary alternating current generator having four field poles *A*; magnetized by a continuous current, and an armature wound with two coils *C* connected together in series. *M* represents an alternating-current motor with, say, four poles *D*, the coils on which are connected in pairs and the pairs connected in series. The motor-armature should have polar projections and closed coils *E*.

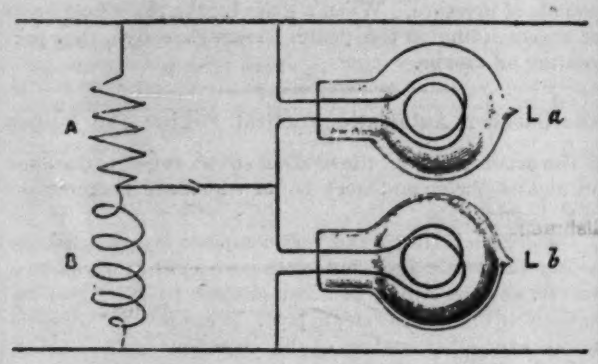
From the common joint or union between the two coils of both the generator and motor an earth-connection *F* is established, while the terminals or ends of the coils which they form are connected to the line-conductors.

Assuming that the motor is a synchronizing motor, or one that has the capability of running in synchronism with the generators, but not of starting, it may be started by the above-described plan by closing the ground-connection from both generator and motor. The system thus becomes one with a two-circuit generator and motor, the ground forming a common return for the currents in the two line wires. When by this arrangement of circuits the motor is brought to speed, the ground connection is broken between the generator or motor, or both, and ground switches *K K* being employed for this purpose. The motor then runs as a synchronizing motor.

On a Shunt Transformer.*

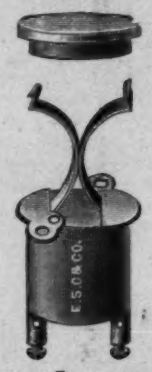
BY E. W. SMITH.

Suppose an alternating potential difference *V* to be maintained between two leads connected by a pair of resistances, *A* and *B*, in series, as shown in the figure. If *A* and *B* have the same impedance, then the potential



SHUNT TRANSFORMER SYSTEM.

difference V_a and V_b at the terminals of *A* and *B*, respectively, will be equal if both the resistance and self-induction are equal in each, viz., $V_a = V_b = \frac{1}{2} V$. If, however, the resistance of *A* is large and non-inductive, while the self-induction of *B* is considerable, then V_a may still



THE GLENDALE LIGHTNING ARRESTER.

be equal to V_b, but V_a will be retarded while V_b will be accelerated.

Let the two leads be connected also by two similar sets of lamps, L_a and L_b in series, as shown in the diagram. Then the potential difference at the terminals of each series would be $\frac{1}{2} V$; but if the junction at the two sets is connected with the junction of the resistances *A* and *B*, the potential difference will become V_a and V_b, respectively, and therefore each set of lamps will become brighter.

The experiment was exhibited and the effect was very marked. The effect of joining the pair of junctions as described will be to increase the current through the inductive resistance as well as through the lamps, while diminishing the current in the main circuit.

The resistance *A* may consist of lamps, and *B* of a coil absorbing very little energy. The inductive resistance has been called by Prof. Ayrton a shunt transformer.

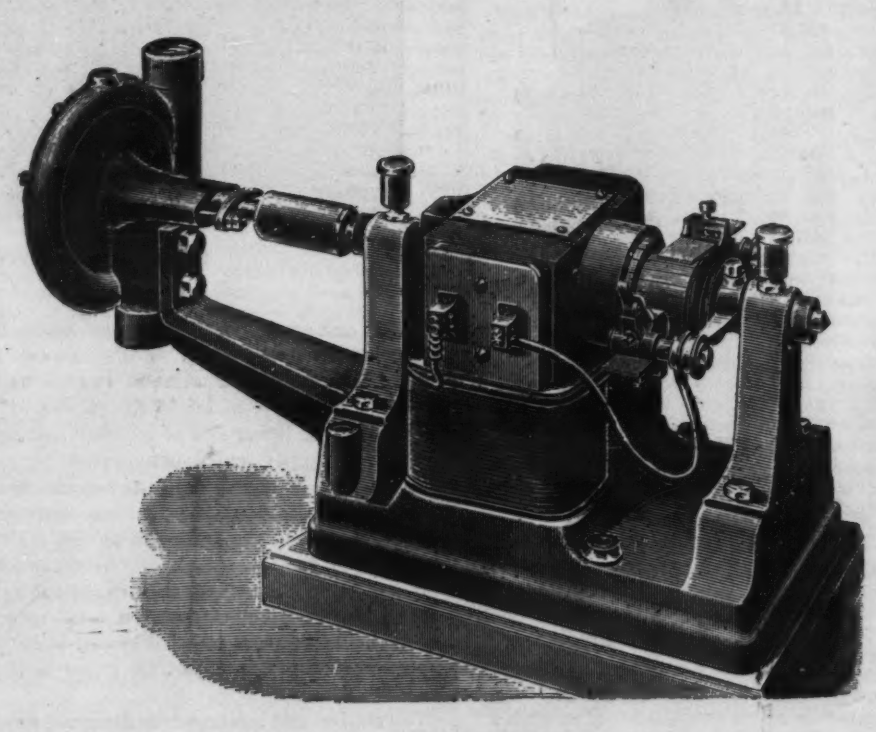
* Abstract of a paper read before the London Physical Society, June 8.

The author stated that he had made similar experiments with Mordey transformers, each wound with three coils, consisting of the same number of turns, one being used as the primary and the other two as independent secondaries. With one circuit comparatively non-inductive and the other inductive, the scalar sum of the amplitudes of the secondary currents was then greater than that of the primary, although the vector sum was of course less.

In conclusion the author pointed out the bearing of the experiment on the importance of devising some means of measuring the amount of energy supplied by electric lighting contractors, instead of merely the number of ampère hours.

An English Electric Pumping Plant.

The accompanying illustration, taken from *Industries*, represents a compact form of combined electric motor and centrifugal pump, which has been supplied by the United Electrical Engineering Company, of London, to the country mansion of Mr. Love, in Easingwold, Yorkshire. The problem which had to be solved in this instance was to utilize the existing electric light installation, in order to provide a water supply to the house which should be as far as possible automatic, and this has been done in the following manner: The cistern of the house is fitted with a float, which follows the rise and fall of the water and by means of a control switch opens or closes the motor circuit respectively when the cistern is full or empty. The current is obtained from storage batteries, and 7.5 ampères at 156 volts is required, the pump being designed to lift 1,200 gallons per hour to a height of 36 ft. through a 1-in. pipe.



A NEAT ELECTRIC PUMPING PLANT.

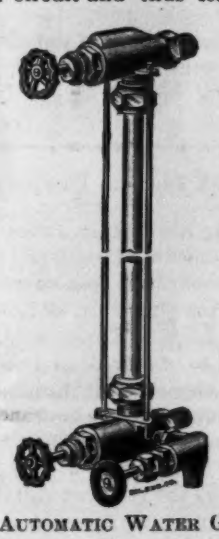
The Glendale Lightning Arrester.

Heretofore, lightning arresters, when mounted in groups, required to be made to order, and no reasonable provision could be made by which the number could be added to as the number of lines increased, or by which one lightning arrester could be readily withdrawn and replaced by another in case of necessity. The "Glendale" lightning arrester has been designed to overcome this difficulty in a simple manner. As will be seen in the accompanying illustration, the arrester consists of a cylindrical plug of baked wood an inch long and made to fit an inch hole, into which it pushes easily. Two binding posts project from the rear end and a pair of springs at the front of the plug are connected with these binding posts. The springs make contact with each other, but may be opened at the contact points so that a slip of paper may be put between the contacts. This slip of paper forms the lightning arrester, the lightning current sparking through it. Very damaging currents will perforate the paper so freely as to establish metallic connection, and thus put on a safety ground. After a storm new papers can be inserted, and the old papers can be marked and retained as a storm record, showing the number of the line, the date, and the perforations showing the effect. The thinner the paper, the more efficient, of course, the arrester will be. Any writing or printing paper will answer, but tissue copying paper will give the best protection. When the lightning arrester is used in this manner the line is simply connected to one binding post, while the other binding-post is put to ground.

There are two metallic flanges on the front end of the plug, and wood screws passing through these flanges hold the plug in the board. There are also two holes entirely through the plug. As a result of this arrangement the wire connections may be made at the binding posts at the rear of the board, or they may be made under the heads of attach-

ing screws in the flanges. Furthermore, the holes in the plug permit the wires to be brought up behind the board and connected in front of the board, or to be brought up in front of the board and connected behind the board, as desired.

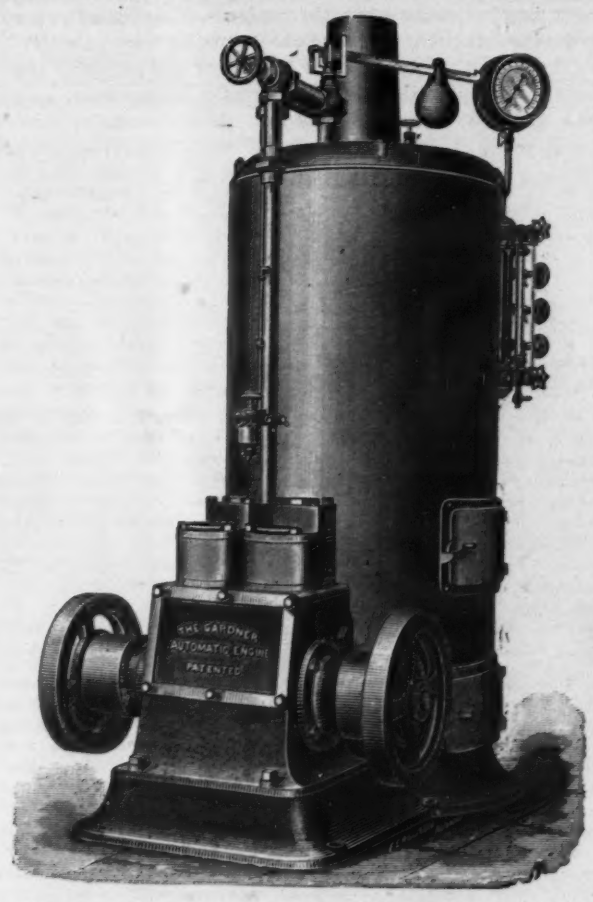
The Glendale lightning arrester may also be used as a thermal cut-out on the foil block principle. This is the preferable plan where it is desired to guard cable wires. The heavy currents are simply caused to melt a weak place in the main circuit and thus leave the line open.



Lang Automatic Water Gauge.

When the lightning arrester is thus used the in-line goes to one binding post and the out-line to the other binding post. The springs are prolonged into clips which will grasp a wooden foil block, the contacts of the spring thus being held apart. A piece of gold foil mounted on gummed paper lies along the foil block. The main circuit is thus through the foil and a damaging current will destroy the foil and leave the line open. After a storm new foil paper must be put in, but temporarily the foil block may be removed, allowing the springs to close their contact and complete the circuit. The foil paper can be furnished already mounted, and although very little time is lost in applying the foil, a few extra blocks already mounted can be kept on hand if desired.

The Glendale lightning arrester is self-contained and not much more complicated than a binding post It is exceedingly cheap and of the greatest efficiency. One of them may be placed wherever it is found convenient to bore an inch hole to stick it in, and similar provision may at any time be made for other lines by simply boring additional holes. Preparations may be made in advance for a large number of arresters by simply providing a board,



Gardner Automatic Vertical Engine and Boiler.

bored symmetrically with a large number of holes, the lightning arresters being inserted in these holes as the lines are added thereto. The arrester is small, and consequently a large number of them may be grouped on a small board. Such a board may be mounted on the operating table of the telephone exchange, or on a wallboard, or on the switchboard of a telephone or telegraph office. It may also be placed at the window, or on house-top fixtures, as convenience may suggest or necessity require.

This simple device is manufactured by The E. S. Greeley & Co., of this city, and is made in but one size, viz., as stated above, with a plug to fit a one-inch hole and long enough to be used in any board not over one inch thick.

Lang Automatic Water Gauge.

The breaking of the glass water gauge attached to boilers through accident or weakness is not an infrequent occurrence, and often damage to plant is caused by the escaping hot water and steam, and much suffering through scalding. To prevent the possibility of such disastrous results, J. Lang & Co., Chicago, have placed on the market a self-closing water guage, containing an automatic device that shuts off escaping water or steam should the glass be broken through any cause whatever. As illustrated herewith, the principle is embodied in a cylinder and piston with two valve seats on the self-acting piston rod. Working on a boiler carrying, say, 60 pounds of steam, the self-acting valves are held open by about 15 pounds of pressure. When a glass breaks the whole force of steam acting on the piston closes the valve, thus preventing all escape.

The Gardner Automatic Vertical Engine and Boiler.

The accompanying illustration shows the new Gardner automatic engine and steel boiler which are made in sizes of 2, 4 and 6 h. p.

The engine is simple and very compact; it is of the single acting automatic type, but with two cylinders and two valves, and the oiling is accomplished by means of an automatic oiler in the steam pipe. It has several improvements over other engines of this class now on the market, and has all the desirable features of a first-class engine for running small lighting plants.

The engine is specially designed for operating small electric light plants, for which purpose its regulating qualities have been specially kept in view. All the working parts of the engine are made of steel and are interchangeable, so that any part can be duplicated at slight expense, and special provisions are made for taking up wear of the moving parts.

The boiler connected with the engine and mounted on the same bed plate is made of steel and consists of a stand pipe, the lower end of which is secured to the base and the upper end surmounted by a dome. The stand pipe is surrounded by a fire pot, having a circular revolving grate, and in the space between the fire pot and under side of the dome are placed a number of circulating pipes, the lower ends of which are screwed into the stand pipe, and the upper ends carried into the dome. In this manner perfect circulation and rapid steaming are secured. In order to prevent loss of heat by radiation the boiler is encased in a double sheet iron jacket packed with asbestos.

The engine and boiler, while designed as a compact combination, are also furnished separately, and their sale has been undertaken by Mr. J. J. McCabe, of this city.

On the Effect of Placing a Ball and Point in a High Tension Alternating Current Circuit.*

G. L. TEEPLE AND W. K. ARCHBOLD.

The work was undertaken in order to investigate a peculiar phenomenon which seems to have been first observed by Mr. E. G. Acheson, of the Standard Underground Cable Company, at Pittsburgh. He had described it as follows: If a ball and a point be connected one to each pole of a source of alternating E. M. F., and also to the terminals of a galvanometer, a deflection as if from a straight current will be observed in the galvanometer.

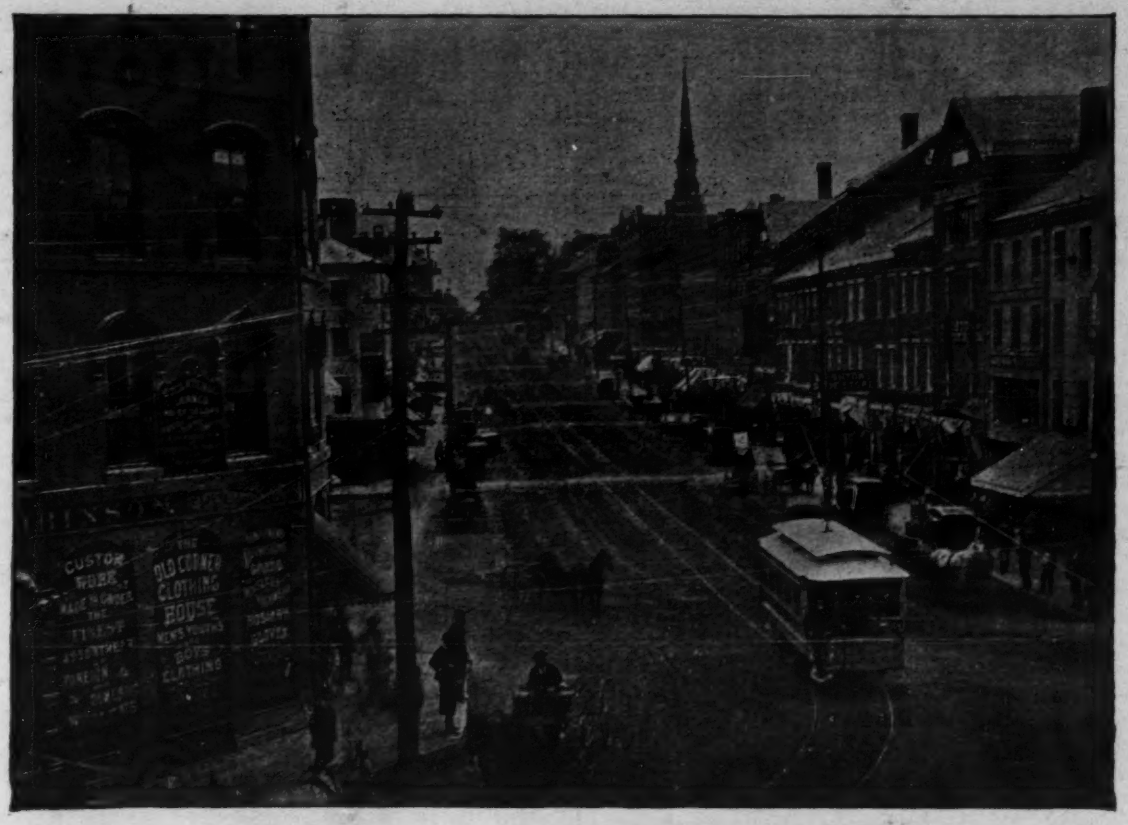
*Abstract of Thesis.—Cornell *Crank.*

It was found that, to get the effect, a high E. M. F. was necessary, and that the point must be brought so close to the ball that an arc forms between the two, and this arc drawn out to certain length, depending on the E. M. F. used and on the resistance in the galvanometer circuit. The arc was shown to be intermittent, corresponding with the alternations, and to conduct apparently much more readily from the point to the ball, than vice versa, so that a very large excess of total current is in the direction from point to ball. A galvanometer placed directly in series with such a ball and point would show, therefore, a marked deflection. The currents used were very small. At present no exact ideas of their size can be given.

Several sets of curves were obtained showing the variation of E. M. F. between ball and point, with small increments of time during a complete wave, both with and without the arc. They verified one another, and showed that as the point came to its highest positive potential the arc suddenly formed, and the potential difference between ball and point immediately dropped to a very low value, and remained there for about one-third of a complete wave, when the arc broke and the potential suddenly changed sign, jumping to its maximum value the other way. No arc forms from ball to point. The curve of total current showed a very large excess of area on one side, as has been before explained. The investigation has been one of a good deal of difficulty, and has brought out one of the very few known differences in the behavior of the two "poles" of an electric current.

The Electric Railway at Bangor, Me.

We illustrate on this page the new electric railway which has been put in at Bangor, Me., on the Thomson-Houston system. The accompanying engraving, made from a photograph, shows a car in West Market Square, the very heart of the city. The road at Bangor is three miles in length, single track, with three turnouts, and contains many sharp curves and grades, the most severe of which is a curve of 35 feet radius which occurs on a grade of 7 per cent. There is one stretch of the road, about three-quarters of a mile in length, which has five curves and an average gradient of 5 per cent. No difficulty, however, is experienced here, and the cars climb those grades with a scarcely perceptible diminution of speed.



THOMSON-HOUSTON ELECTRIC RAILWAY, AT BANGOR, ME.

There are four 16-foot cars, made by the Newburyport Car Manufacturing Company, which are handsomely finished and equipped with two 15 h. p. Thomson-Houston motors. Three cars are in operation from 5 A. M. till 11:30 P. M., the fourth being held in reserve for special occasions.

The power plant consists of one 80 h. p. Thomson-Houston generator, with the necessary station fittings, driven by a 14 × 13 Armington & Sims' engine, running at a speed of 250 revolutions per minute. This is the only tramway which has ever been constructed in Bangor, and it has from the very start given the utmost satisfaction, but one schedule trip having been missed since the day of starting, May 21. The travel has been very heavy, averaging 1,600 passengers per day, and on one day 5,000 were carried by three cars.

The success of the road has been such that extensions have been asked for in many parts of the city, and it is probable that before long the equipment will be greatly increased.

Cornell Electrical Notes.

Cornell University attained her majority during the past week; the twenty-first annual commencement exercises occuring June 16–20.

The past year has been an especially prosperous one for the electrical department. Nineteen students received the degree of M. E. with a statement in their diploma that special attention had been paid to electrical work, this being the usual form of diploma granted to those graduating in the electrical engineering course.

The physical laboratory has been very appropriately named Franklin Hall.

Two terms of two hours each, shopwork, have been added to the senior year of the electrical engineering course. The change does not meet with favor among the students.

The trustees at their last meeting voted to raise the tuition during and after 1890–91 from $75 to $125 per annum.

The exhibition of the thesis drawings of technical students was very attractive and interesting. Among the drawings were a number of dynamos, regulating switches, ammeters and other electrical apparatus.

Board of Electrical Control.

A very animated meeting of the Board of Electrical Control was held on June 26. Several lawyers and other representatives of the various electrical companies were present, and there were early signs that the session would be a lively one.

The proceedings were opened by Commissioner Gibbens proposing that power should be vested in the secretary of the board to sign permits for the erection of poles and wires when the board was not in session. The Mayor strenuously opposed this proposition and gave very decidedly his opinion that the granting of such permits should remain the exclusive prerogative of the board in session, and he deprecated the delegation of any such power beyond those lines.

A report of the engineer of the board was ordered to be spread on the minutes, as also was a report of the Commissioner of Public Works with reference to poles and wires. Applications of various kinds were made by the Western Union Company, the Dock Department, the Electric Power Company, the New York Lighting Company and others, some of which were granted. Commissioner Gibbens then stated that from the report of the engineer, submitted at the last meeting of the Board, he had drawn up a resolution to the effect that subways for electric light wires be built in Broadway, from Fourteenth street to Bowling Green, and in Forty-second and Fifty-ninth streets, from First avenue to Broadway, and on other streets that are to be repaved.

The Mayor said he believed in doing something before the summer was over. He wanted to go right at it and get it finished. Commissioner Gibbens urged the building of a subway down the Bowery, from Fourteenth street to Chatham Square; the Mayor, however, was in favor of making the line of the subways right up Third avenue. While discussing this matter, the Mayor asked the engineer of the board what progress had been made in the construction of subways already ordered. Mr. Kearney said that West Twenty-third, West Twenty ninth and many other streets where subways had been ordered were as yet untouched. The engineer of the construction company was then called upon to explain the cause of this omission. He said the construction company had already built twenty miles of subway this year, and it was proceeding actively with its operations. So far as the Twenty-third street work was concerned, it was ready to push as soon as the Westinghouse and United States companies had their stations at the foot of West Twenty-fourth street available. Here Mr. Cravath, representing the United States Company, rose and showed at length how that company had been enlarging its plant for a wide range of business, only to find that it was going to be cramped and hindered in its operations by the insufficiency of subway accommodation. He complained of the partiality which had been shown to the Edison Company, which could build subways when and where it liked, and he did not see why, when the United States Company was willing to build its own subways, it could not be allowed a similar privilege. Its station would be ready in 30 days, and it then wanted the subway to go into. The Mayor then asked Mr. Beckwith how long it would be before the subways ordered could be completed. Mr. Beckwith hoped to have them ready by the end of the season, but it was difficult, he said, to name a positive date, owing to the uncertainty of the amount of other work that might intervene. A considerable amount of skirmishing ensued, in which Mr. Cohen, the legal representative of the construction company, Mr. Beckwith, and the Mayor took part. The latter succeeded in carrying his point, and the subways will have to be finished by December 1.

Commissioner Gibbens' resolution was amended so as to make provision for a trunk line subway in Third avenue to Chatham Square, in addition to the subways in Broadway and East Forty-second and Fifty-ninth streets. Mr. Kearney's estimate for the length of the newly ordered conduits is 325 miles. If constructed of iron pipe at 20 cents a foot, they will coss $343,000, exclusive of cost of labor, or $1,200,000 in all.

From the report of the engineer of the construction company, it appears that of the 40,000 feet of telegraph and telephone subways sanctioned previous to the present year 10,000 feet were completed or in progress, while of the 189,600 feet of electric light subways authorized 14,000 feet were completed or in progress. Of the subways ordered this year, 480,900 feet in all, 195,000 have been completed. The total subway work accomplished since May is 250,000 feet.

Among the new subways ordered is one on Broad and Nassau streets from Exchange Place to Pine street.

The East River Electric Company, whose wires on Park Row were removed ten days ago, applied for leave to put up temporary poles. The Mayor, however, thought that a subway along Park Row would be better for the company as well as the public, and the application was refused.

Amongst a large number of applications for stringing wires for electric lighting was one from the Manhattan Electric Light Company. The Mayor called the attention of the board to the fact that an application from this company for the completion of its First Avenue line had been granted in February, last, but he had discovered that the permit issued in conformity with his resolution had been made so broad as to practically allow the company to string wires anywhere. The resolution was hunted up and very promptly revoked. During the meeting the old question of iron pipes versus cement conduits cropped up, and it is understood that a request for permission to use the latter will be formally made by the United States Company at the next meeting of the board, and other companies will have an opportunity of speaking in favor of any particular system for which they may happen to have a preference.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, July 1, 1889.

The Mount Morris Station, New York City, is now being belted up by the Charles Munson Belting Company, of Chicago which has lately had an enormous run of work in the East, and bids fair to remain in permanent occupation of the territory.

The New American System.—In my recent notes on the system of the American Electrical Arc Light Company the hearty commendation on the system from the Edison Company, of York, Pa., was made to read by the types as coming from the New York local company. I hasten to make the correction.

The Edison Phonograph.—I hear that Mr. Edison received last week a phonograph cylinder from England, containing the English bugle calls. This was sent to him in return for one recently sent by him to England with American bugle calls. Upon placing the cylinder in the machine, the calls are at once repeated in a beautifully clear and distinct manner, and the pleasure given is great.

Mr. R. L. Shainwald, president and general manager of the Standard Paint Company, 59 Maiden Lane, manufacturers of the celebrated P. & B. electrical compound, has started on his way to England and the continent of Europe to attend to business connected with the French and English patents, also to give prominence to the exhibition of the Standard Paint Company at the Paris Exposition.

Mr. C. S. Van Nuis, 18 Cortlandt street, is busily engaged as consulting electrical engineer. He has been one of the most successful Edison engineers. Among the contracts executed by Mr. Van Nuis may be mentioned the central station at Little Falls, N. Y.; the central stations at Charlottesville, Va.; Rochester, N. Y., started with 4,000 lamps; Milford, Del., with 1,000 lamps, and numerous isolated plants for the Edison Company.

A Fatal Shock.—Edward Quinn, who for several years has been in charge of the dynamo room of the Brush Electric Light Company at No. 210 Elizabeth street, caught hold of a live wire on the night of June 26 and was killed by the shock. There had been a discussion in the works about a wire which was thought to be dangerous, but Quinn insisted that it was dead, and to prove it procured a ground wire and mounted a short step ladder. No sooner had he touched the wire than his fatal mistake was made evident.

Mr. Harry Hall has recently shown a marked taste for partnerships. Last week I had the pleasure of chronicling his marriage and now it is my agreeable duty to mention that he has become a member of the well-known electrical firm of Hazazer & Stanley, with whom he has of late been actively associated. There will be no change in the firm name. Mr. Hall is a young man, well known and popular, and all his many friends will wish him long years of abundant prosperity in the development of electrical industries.

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Vienna Soft-Cored Carbons.—About three months ago we noted the visit to this country of Mr. M. Hardtmuth, of the well-known European firm of F. Hardtmuth & Co., one of the leading and oldest pencil houses of the world. Some few years ago the nature of its business led the firm to go into the production of carbon points for arc lamps, and its success in this department is in Europe, at least, a matter of common repute, the Vienna or Austrian soft cored carbons being familiar to anybody who has the slightest interest in the business. During his visit to this country Mr. Hardtmuth took occasion to give the carbons a practical test in the presence of those competent to judge of their merits, and the carbons went through the ordeal in a very satisfactory manner. With lamps using these soft cored carbons there is remarkable steadiness, and not less noticeable absence of flickering and sputtering. Owing to the fact that the core of the carbon is soft, the arc, instead of traveling about from one side to the other of the carbon, as the resistance of the material may happen to vary at the instant, stays persistently and uniformly at the very centre of the carbon, so that the arc is maintained at the heart of the crater and the lamp yields all the light that is possible and within its compass. Not only is there this desirable gain in steadiness, rendering the arc lamp comparable to the incandescent, but there is also no small economy of current, a lamp trimmed with these carbons supplying a full arc on the consumption of two or three ampères less than is the case with carbons of the ordinary type. Some tests having been made at Harlem and elsewhere with this Vienna carbon, the exclusive agency for them was secured by the enterprising Empire City Electric Company, of this city, the matter being specially intrusted to the care of Mr. H. D. Hall. I now learn from that gentleman that the company have just received a large shipment of these carbons, and are ready tofill orders for them in the regular sizes. I think it would be a great point gained in the electrical industry if these carbons were generally adopted for indoo work. They will burn from 12 to 14 hours and upward, requiring little attention for the lamp they are in, while their brilliancy, steadiness and whiteness of light are such as to recommend them for a great many places from which arc lights have heretofore been excluded. In fact, I am confident that many of the companies, on giving them a trial, will find it much easier to work up indoor patronage and to hold their customers when secured.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, June 29, 1889.

Connecticut Legislature.—The Connecticut Legislature adjourned sine die this week. Among the important bills passed this session, the bill taxing telegraph and telephone companies on their wire mileage is interesting to the electrical fraternity.

Salem, Mass.—The citizens of this city have not been satisfied with their telegraph service for some time past, but are now pleased with the promise of better attention on the part of the Western Union Telegraph Company, who will open new and more commodious offices on Essex street.

Hartford, Conn.—The Edison Graphophone Company have determined to establish a factory in this city for the purpose of manufacturing their instruments. They have leased two entire floors of the factory of Colts Arms Company, and will commence operations at once, employing several hundred men.

Randolph, Vt.—This city is at present considering the application of six electric light companies for a franchise. The selectmen have decided that either the Westinghouse or the Thomson-Houston systems will be adopted, but have not yet decided, though there seems to be a feeling in favor of Westinghouse.

Beverly, Mass.—The selectmen of this town have been petitioned by the Robinson-Foster Electric Motor Company, of Boston, for permission to establish a plant for the purpose of furnishing electric power for manufacturing purposes. The selectmen will give them a hearing on July 2, when it is to be hoped they will give a favorable answer.

Newport, R. I.—The promotors of the electric railroad in this most fashionable summer resort are meeting with the most bitter opposition from the summer residents. A meeting was held this week at the house of one of the summer visitors, at which it was resolved to form a protective association to prevent the completion of the road. Mr. Titus, president of the railroad, states, however, that the road will be built, and that he will call on the police force if necessary to protect his men at their work.

Dedham, Mass.—The controversy between the Dedham & Hyde Park Gas and Electric Company and the Dedham ElectricCompany has been at last settled, the selectmen of the city granting the franchise to the Dedham Electric Company. This company has closed a contract with the Thomson-Houston Electric Company to furnish the complete installation of the plant, and to furnish them with such apparatus as future years may demand. The Dedham Electric Company have secured a contract for lighting the streets for 10 years, a length of term which has occasioned considerable surprise.

Thomson International Electric Welding Company.—This will be the name of a new company which it is proposed to organize, to purchase and control all of Prof. Elihu Thomson's patents for electric welding, for Great Britain and the countries of continental Europe. The stockholders of the Thomson Electric Welding Company have been offered the privilege of subscribing for one share of stock in the new company for each share of stock they hold in the Thomson Electric Welding Company. The International Company will be capitalized at not less than $1,500 000, and as the Electric Welding Company's capital is $500.000, it leaves a balance of $1 000,000, which has already been pledged by private subscription.

The Edison Phonograph Toy Manufacturing Company have called a meeting of stockholders at Portland, Me., for July 3, to increase the capital stock from 60,000 to 100,000 shares, representing $600,000 to $1,000,000, and to give the directors authority for disposing of the same. Of these shares 24,000 will go to Mr. Edison, Mr. Madden, Mr. Gilliland and others, for the purpose of securing Mr. Edison's services in the manufacturing for both foreign and domestic markets, and also improvements and new inventions, already made or to be made by him during the next five years. The remaining 16,000 shares will be retained in the treasury for the present, to be used in obtaining other new inventions and improvements, and in developing the business of the company.

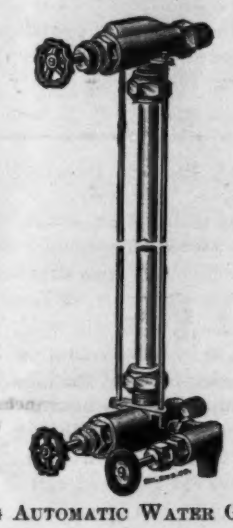
Boston Gas Light Company.—The Board of Health has been requested to investigate and report to the City Council whether the works of the Boston Gas Company, on Prince street, are conducted according to their charter, inasmuch as the present methods tend to the discomfort and ill-health and inconvenience of large numbers of persons residing in the neighborhood. Electricians will admit that it is a precarious thing for any man to touch an electric arc light wire, if he desires to keep his health, and any sensible man will avoid the danger; but the danger arising from gas is not so apparent, and one may be unconsciously sowing the seeds of disease by breathing the air in his own dwelling permeated by the obnoxious gaseous fumes from the gas works in the vicinity.

West End Railroad.—It is interesting to note that at present, wherever this company are laying new tracks, they are putting down their work in a very substantial manner, in expectation that the roads before long will all be operated by electricity. The rails are being provided with a ground wire, which connects each section of rail with the adjacent one. The Boylston street line is being pushed vigorously along, and the only difficulty to contend with now is the necessity for either cutting many of the branches of the beautiful trees in the Public Gardens to make room for the contact wire, or moving the tracks more towards the other side of the street. When the work is completed this line will be one of the most thoroughly equipped electric railways in the country, and, owing to its strong and heavy construction, will be better able than ever to withstand the effects of the severest winter.

Opening of the Marlborough, Mass., Electric Railway.—On June 18 the Marlborough electric railway, installed by the Sprague Electric Railway and Motor Company, of New York, was put into operation. This road is equipped with the improved Sprague electric railway motors, and has already carried a very large number of passengers. On the trial trip there were a number of street railway and electrical men from different parts of New England, including Hon. S. C. Darling, Mr. Noyes, ex-president of the South Boston Railway Surface Company; James S. Murphy, Edward Blake and representatives from the Selectmen from Marlborough and others. On the first day of operation the cars on this line carried 1,400 people, on the second day nearly 2,000, and on the third day a still greater number, making more than a quarter of the entire population of the town during the three days' duration. At present half of these cars tow trail cars, in order to increase their capacity, and the cars are so crowded that the management of the

ing screws in the flanges. Furthermore, the holes in the plug permit the wires to be brought up behind the board and connected in front of the board, or to be brought up in front of the board and connected behind the board, as desired.

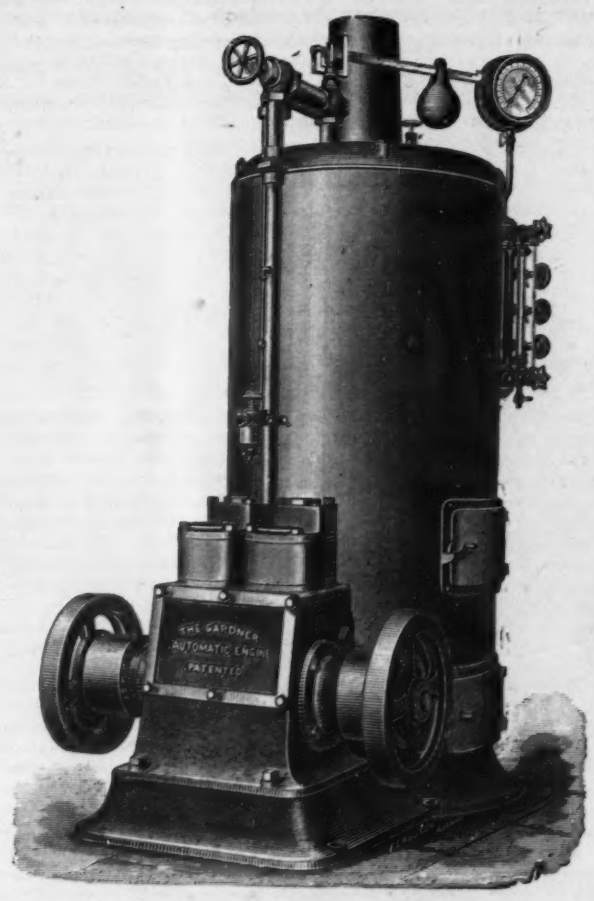
The Glendale lightning arrester may also be used as a thermal cut-out on the foil block principle. This is the preferable plan where it is desired to guard cable wires. The heavy currents are simply caused to melt a weak place in the main circuit and thus leave the line open.



Lang Automatic Water Gauge.

When the lightning arrester is thus used the in-line goes to one binding post and the out-line to the other binding post. The springs are prolonged into clips which will grasp a wooden foil block, the contacts of the spring thus being held apart. A piece of gold foil mounted on gummed paper lies along the foil block. The main circuit is thus through the foil and a damaging current will destroy the foil and leave the line open. After a storm new foil paper must be put in, but temporarily the foil block may be removed, allowing the springs to close their contact and complete the circuit. The foil paper can be furnished already mounted, and although very little time is lost in applying the foil, a few extra blocks already mounted can be kept on hand if desired.

The Glendale lightning arrester is self-contained and not much more complicated than a binding post It is exceedingly cheap and of the greatest efficiency. One of them may be placed wherever it is found convenient to bore an inch hole to stick it in, and similar provision may at any time be made for other lines by simply boring additional holes. Preparations may be made in advance for a large number of arresters by simply providing a board,



Gardner Automatic Vertical Engine and Boiler.

bored symmetrically with a large number of holes, the lightning arresters being inserted in these holes as the lines are added thereto. The arrester is small, and consequently a large number of them may be grouped on a small board. Such a board may be mounted on the operating table of the telephone exchange, or on a wallboard, or on the switchboard of a telephone or telegraph office. It may also be placed at the window, or on house-top fixtures, as convenience may suggest or necessity require.

This simple device is manufactured by The E. S. Greeley & Co., of this city, and is made in but one size, viz., as stated above, with a plug to fit a one-inch hole and long enough to be used in any board not over one inch thick.

Lang Automatic Water Gauge.

The breaking of the glass water gauge attached to boilers through accident or weakness is not an infrequent occurrence, and often damage to plant is caused by the escaping hot water and steam, and much suffering through scalding. To prevent the possibility of such disastrous results, J. Lang & Co., Chicago, have placed on the market a self-closing water guage, containing an automatic device that shuts off escaping water or steam should the glass be broken through any cause whatever. As illustrated herewith, the principle is embodied in a cylinder and piston with two valve seats on the self-acting piston rod. Working on a boiler carrying, say, 60 pounds of steam, the self-acting valves are held open by about 15 pounds of pressure. When a glass breaks the whole force of steam acting on the piston closes the valve, thus preventing all escape.

The Gardner Automatic Vertical Engine and Boiler.

The accompanying illustration shows the new Gardner automatic engine and steel boiler which are made in sizes of 2, 4 and 6 h. p.

The engine is simple and very compact; it is of the single acting automatic type, but with two cylinders and two valves, and the oiling is accomplished by means of an automatic oiler in the steam pipe. It has several improvements over other engines of this class now on the market, and has all the desirable features of a first-class engine for running small lighting plants.

The engine is specially designed for operating small electric light plants, for which purpose its regulating qualities have been specially kept in view. All the working parts of the engine are made of steel and are interchangeable, so that any part can be duplicated at slight expense, and special provisions are made for taking up wear of the moving parts.

The boiler connected with the engine and mounted on the same bed plate is made of steel and consists of a stand pipe, the lower end of which is secured to the base and the upper end surmounted by a dome. The stand pipe is surrounded by a fire pot, having a circular revolving grate, and in the space between the fire pot and under side of the dome are placed a number of circulating pipes, the lower ends of which are screwed into the stand pipe, and the upper ends carried into the dome. In this manner perfect circulation and rapid steaming are secured. In order to prevent loss of heat by radiation the boiler is encased in a double sheet iron jacket packed with asbestos.

The engine and boiler, while designed as a compact combination, are also furnished separately, and their sale has been undertaken by Mr. J. J. McCabe, of this city.

On the Effect of Placing a Ball and Point in a High Tension Alternating Current Circuit.*

G. L. TEEPLE AND W. K. ARCHBOLD.

The work was undertaken in order to investigate a peculiar phenomenon which seems to have been first observed by Mr. E. G. Acheson, of the Standard Underground Cable Company, at Pittsburgh. He had described it as follows: If a ball and a point be connected one to each pole of a source of alternating E. M. F., and also to the terminals of a galvanometer, a deflection as if from a straight current will be observed in the galvanometer.

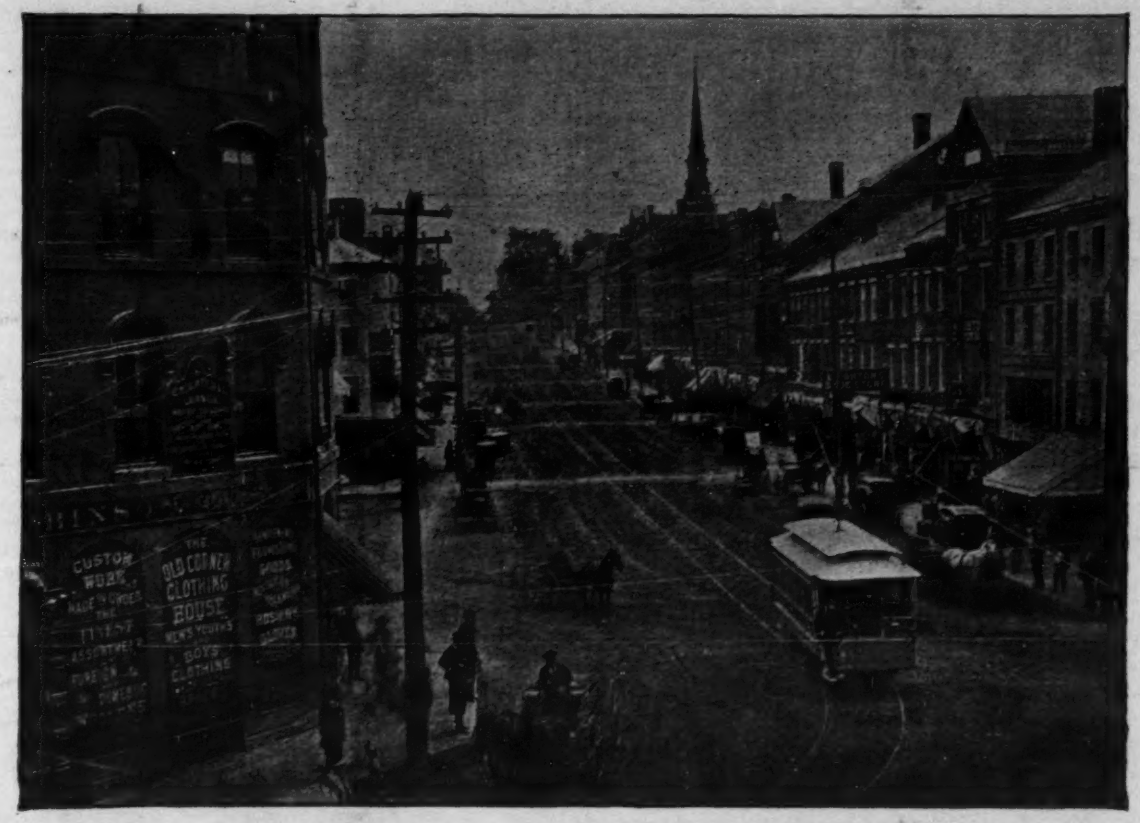
*Abstract of Thesis.—Cornell *Crank*.

It was found that, to get the effect, a high E. M. F. was necessary, and that the point must be brought so close to the ball that an arc forms between the two, and this arc drawn out to certain length, depending on the E. M. F. used and on the resistance in the galvanometer circuit. The arc was shown to be intermittent, corresponding with the alternations, and to conduct apparently much more readily from the point to the ball, than vice versa, so that a very large excess of total current is in the direction from point to ball. A galvanometer placed directly in series with such a ball and point would show, therefore, a marked deflection. The currents used were very small. At present no exact ideas of their size can be given.

Several sets of curves were obtained showing the variation of E. M. F. between ball and point, with small increments of time during a complete wave, both with and without the arc. They verified one another, and showed that as the point came to its highest positive potential the arc suddenly formed, and the potential difference between ball and point immediately dropped to a very low value, and remained there for about one-third of a complete wave, when the arc broke and the potential suddenly changed sign, jumping to its maximum value the other way. No arc forms from ball to point. The curve of total current showed a very large excess of area on one side, as has been before explained. The investigation has been one of a good deal of difficulty, and has brought out one of the very few known differences in the behavior of the two "poles" of an electric current.

The Electric Railway at Bangor, Me.

We illustrate on this page the new electric railway which has been put in at Bangor, Me., on the Thomson-Houston system. The accompanying engraving, made from a photograph, shows a car in West Market Square, the very heart of the city. The road at Bangor is three miles in length, single track, with three turnouts, and contains many sharp curves and grades, the most severe of which is a curve of 35 feet radius which occurs on a grade of 7 per cent. There is one stretch of the road, about three-quarters of a mile in length, which has five curves and an average gradient of 5 per cent. No difficulty, however, is experienced here, and the cars climb those grades with a scarcely perceptible diminution of speed.



THOMSON-HOUSTON ELECTRIC RAILWAY, AT BANGOR, ME.

There are four 16-foot cars, made by the Newburyport Car Manufacturing Company, which are handsomely finished and equipped with two 15 h. p. Thomson-Houston motors. Three cars are in operation from 5 A. M. till 11:30 P. M., the fourth being held in reserve for special occasions.

The power plant consists of one 80 h. p. Thomson-Houston generator, with the necessary station fittings, driven by a 14 × 13 Armington & Sims' engine, running at a speed of 250 revolutions per minute. This is the only tramway which has ever been constructed in Bangor, and it has from the very start given the utmost satisfaction, but one schedule trip having been missed since the day of starting, May 21. The travel has been very heavy, averaging 1,600 passengers per day, and on one day 5,000 were carried by three cars.

The success of the road has been such that extensions have been asked for in many parts of the city, and it is probable that before long the equipment will be greatly increased.

Cornell Electrical Notes.

Cornell University attained her majority during the past week; the twenty-first annual commencement exercises occuring June 16-20.

The past year has been an especially prosperous one for the electrical department. Nineteen students received the degree of M. E. with a statement in their diploma that special attention had been paid to electrical work, this being the usual form of diploma granted to those graduating in the electrical engineering course.

The physical laboratory has been very appropriately named Franklin Hall.

Two terms of two hours each, shopwork, have been added to the senior year of the electrical engineering course. The change does not meet with favor among the students.

The trustees at their last meeting voted to raise the tuition during and after 1890-91 from $75 to $125 per annum.

The exhibition of the thesis drawings of technical students was very attractive and interesting. Among the drawings were a number of dynamos, regulating switches, ammeters and other electrical apparatus.

Board of Electrical Control.

A very animated meeting of the Board of Electrical Control was held on June 26. Several lawyers and other representatives of the various electrical companies were present, and there were early signs that the session would be a lively one.

The proceedings were opened by Commissioner Gibbens proposing that power should be vested in the secretary of the board to sign permits for the erection of poles and wires when the board was not in session. The Mayor strenuously opposed this proposition and gave very decidedly his opinion that the granting of such permits should remain the exclusive prerogative of the board in session, and he deprecated the delegation of any such power beyond those lines.

A report of the engineer of the board was ordered to be spread on the minutes, as also was a report of the Commissioner of Public Works with reference to poles and wires. Applications of various kinds were made by the Western Union Company, the Dock Department, the Electric Power Company, the New York Lighting Company and others, some of which were granted. Commissioner Gibbens then stated that from the report of the engineer, submitted at the last meeting of the Board, he had drawn up a resolution to the effect that subways for electric light wires be built in Broadway, from Fourteenth street to Bowling Green, and in Forty-second and Fifty-ninth streets, from First avenue to Broadway, and on other streets that are to be repaved.

The Mayor said he believed in doing something before the summer was over. He wanted to go right at it and get it finished. Commissioner Gibbens urged the building of a subway down the Bowery, from Fourteenth street to Chatham Square; the Mayor, however, was in favor of making the line of the subways right up Third avenue. While discussing this matter, the Mayor asked the engineer of the board what progress had been made in the construction of subways already ordered. Mr. Kearney said that West Twenty-third, West Twenty ninth and many other streets where subways had been ordered were as yet untouched. The engineer of the construction company was then called upon to explain the cause of this omission. He said the construction company had already built twenty miles of subway this year, and it was proceeding actively with its operations. So far as the Twenty-third street work was concerned, it was ready to push as soon as the Westinghouse and United States companies had their stations at the foot of West Twenty-fourth street available. Here Mr. Cravath, representing the United States Company, rose and showed at length how that company had been enlarging its plant for a wide range of business, only to find that it was going to be cramped and hindered in its operations by the insufficiency of subway accommodation. He complained of the partiality which had been shown to the Edison Company, which could build subways when and where it liked, and he did not see why, when the United States Company was willing to build its own subways, it could not be allowed a similar privilege. Its station would be ready in 30 days, and it then wanted the subway to go into. The Mayor then asked Mr. Beckwith how long it would be before the subways ordered could be completed. Mr. Beckwith hoped to have them ready by the end of the season, but it was difficult, he said, to name a positive date, owing to the uncertainty of the amount of other work that might intervene. A considerable amount of skirmishing ensued, in which Mr. Cohen, the legal representative of the construction company, Mr. Beckwith, and the Mayor took part. The latter succeeded in carrying his point, and the subways will have to be finished by December 1.

Commissioner Gibbens' resolution was amended so as to make provision for a trunk line subway in Third avenue to Chatham Square, in addition to the subways in Broadway and East Forty-second and Fifty-ninth streets. Mr. Kearney's estimate for the length of the newly ordered conduits is 325 miles. If constructed of iron pipe at 20 cents a foot, they will coss $343,000, exclusive of cost of labor, or $1,200,000 in all.

From the report of the engineer of the construction company, it appears that of the 40,000 feet of telegraph and telephone subways sanctioned previous to the present year 10,000 feet were completed or in progress, while of the 189,600 feet of electric light subways authorized 14,000 feet were completed or in progress. Of the subways ordered this year, 480,900 feet in all, 195,000 have been completed. The total subway work accomplished since May is 250,000 feet.

Among the new subways ordered is one on Broad and Nassau streets from Exchange Place to Pine street.

The East River Electric Company, whose wires on Park Row were removed ten days ago, applied for leave to put up temporary poles. The Mayor, however, thought that a subway along Park Row would be better for the company as well as the public, and the application was refused.

Amongst a large number of applications for stringing wires for electric lighting was one from the Manhattan Electric Light Company. The Mayor called the attention of the board to the fact that an application from this company for the completion of its First Avenue line had been granted in February, last, but he had discovered that the permit issued in conformity with his resolution had been made so broad as to practically allow the company to string wires anywhere. The resolution was hunted up and very promptly revoked. During the meeting the old question of iron pipes versus cement conduits cropped up, and it is understood that a request for permission to use the latter will be formally made by the United States Company at the next meeting of the board, and other companies will have an opportunity of speaking in favor of any particular system for which they may happen to have a preference.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, July 1, 1889.

The Mount Morris Station, New York City, is now being belted up by the Charles Munson Belting Company, of Chicago which has lately had an enormous run of work in the East, and bids fair to remain in permanent occupation of the territory.

The New American System.—In my recent notes on the system of the American Electrical Arc Light Company the hearty commendation on the system from the Edison Company, of York, Pa., was made to read by the types as coming from the New York local company. I hasten to make the correction.

The Edison Phonograph.—I hear that Mr. Edison received last week a phonograph cylinder from England, containing the English bugle calls. This was sent to him in return for one recently sent by him to England with American bugle calls. Upon placing the cylinder in the machine, the calls are at once repeated in a beautifully clear and distinct manner, and the pleasure given is great.

Mr. R. L. Shainwald, president and general manager of the Standard Paint Company, 59 Maiden Lane, manufacturers of the celebrated P. & B. electrical compound, has started on his way to England and the continent of Europe to attend to business connected with the French and English patents, also to give prominence to the exhibition of the Standard Paint Company at the Paris Exposition.

Mr. C. S. Van Nuis, 18 Cortlandt street, is busily engaged as consulting electrical engineer. He has been one of the most successful Edison engineers. Among the contracts executed by Mr. Van Nuis may be mentioned the central station at Little Falls, N. Y.; the central stations at Charlottesville, Va.; Rochester, N. Y., started with 4,000 lamps; Milford, Del., with 1,000 lamps, and numerous isolated plants for the Edison Company.

A Fatal Shock.—Edward Quinn, who for several years has been in charge of the dynamo room of the Brush Electric Light Company at No. 210 Elizabeth street, caught hold of a live wire on the night of June 26 and was killed by the shock. There had been a discussion in the works about a wire which was thought to be dangerous, but Quinn insisted that it was dead, and to prove it procured a ground wire and mounted a short step ladder. No sooner had he touched the wire than his fatal mistake was made evident.

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Salem, Mass.—The citizens of this city have not been satisfied with their telegraph service for some time past, but are now pleased with the promise of better attention on the part of the Western Union Telegraph Company, who will open new and more commodious offices on Essex street.

Hartford, Conn.—The Edison Graphophone Company have determined to establish a factory in this city for the purpose of manufacturing their instruments. They have leased two entire floors of the factory of Colts Arms Company, and will commence operations at once, employing several hundred men.

Randolph, Vt.—This city is at present considering the application of six electric light companies for a franchise. The selectmen have decided that either the Westinghouse or the Thomson-Houston systems will be adopted, but have not yet decided, though there seems to be a feeling in favor of Westinghouse.

Beverly, Mass.—The selectmen of this town have been petitioned by the Robinson-Foster Electric Motor Company, of Boston, for permission to establish a plant for the purpose of furnishing electric power for manufacturing purposes. The selectmen will give them a hearing on July 2, when it is to be hoped they will give a favorable answer.

Newport, R. I.—The promotors of the electric railroad in this most fashionable summer resort are meeting with the most bitter opposition from the summer residents. A meeting was held this week at the house of one of the summer visitors, at which it was resolved to form a protective association to prevent the completion of the road. Mr. Titus, president of the railroad, states, however, that the road will be built, and that he will call on the police force if necessary to protect his men at their work.

Dedham, Mass.—The controversy between the Dedham & Hyde Park Gas and Electric Company and the Dedham Electric Company has been at last settled, the selectmen of the city granting the franchise to the Dedham Electric Company. This company has closed a contract with the Thomson-Houston Electric Company to furnish the complete installation of the plant, and to furnish them with such apparatus as future years may demand. The Dedham Electric Company have secured a contract for lighting the streets for 10 years, a length of term which has occasioned considerable surprise.

Thomson International Electric Welding Company.—This will be the name of a new company which it is proposed to organize, to purchase and control all of Prof. Elihu Thomson's patents for electric welding, for Great Britain and the countries of continental Europe. The stockholders of the Thomson Electric Welding Company have been offered the privilege of subscribing for one share of stock in the new company for each share of stock they hold in the Thomson Electric Welding Company. The International Company will be capitalized at not less than $1,500 000, and as the Electric Welding Company's capital is $500.000, it leaves a balance of $1 000,000, which has already been pledged by private subscription.

The Edison Phonograph Toy Manufacturing Company have called a meeting of stockholders at Portland, Me., for July 3, to increase the capital stock from 60,000 to 100,000 shares, representing $600,000 to $1,000,000, and to give the directors authority for disposing of the same. Of these shares 24,000 will go to Mr. Edison, Mr. Madden, Mr. Gilliland and others, for the purpose of securing Mr. Edison's services in the manufacturing for both foreign and domestic markets, and also improvements and new inventions, already made or to be made by him during the next five years. The remaining 16,000 shares will be retained in the treasury for the present, to be used in obtaining other new inventions and improvements, and in developing the business of the company.

Boston Gas Light Company.—The Board of Health has been requested to investigate and report to the City Council whether the works of the Boston Gas Company, on Prince street, are conducted according to their charter, inasmuch as the present methods tend to the discomfort and ill-health and inconvenience of large numbers of persons residing in the neighborhood. Electricians will admit that it is a precarious thing for any man to touch an electric arc light wire, if he desires to keep his health, and any sensible man will avoid the danger; but the danger arising from gas is not so apparent, and one may be unconsciously sowing the seeds of disease by breathing the air in his own dwelling permeated by the obnoxious gaseous fumes from the gas works in the vicinity.

West End Railroad.—It is interesting to note that at present, wherever this company are laying new tracks, they are putting down their work in a very substantial manner, in expectation that the roads before long will all be operated by electricity. The rails are being provided with a ground wire, which connects each section of rail with the adjacent one. The Boylston street line is being pushed vigorously along, and the only difficulty to contend with now is the necessity for either cutting many of the branches of the beautiful trees in the Public Gardens to make room for the contact wire, or moving the tracks more towards the other side of the street. When the work is completed this line will be one of the most thoroughly equipped electric railways in the country, and, owing to its strong and heavy construction, will be better able than ever to withstand the effects of the severest winter.

Opening of the Marlborough, Mass., Electric Railway.—On June 18 the Marlborough electric railway, installed by the Sprague Electric Railway and Motor Company, of New York, was put into operation. This road is equipped with the improved Sprague electric railway motors, and has already carried a very large number of passengers. On the trial trip there were a number of street railway and electrical men from different parts of New England, including Hon. S. C. Darling, Mr. Noyes, ex-president of the South Boston Railway Surface Company; James S. Murphy, Edward Blake and representatives from the Selectmen from Marlborough and others. On the first day of operation the cars on this line carried 1,400 people, on the second day nearly 2,000, and on the third day a still greater number, making more than a quarter of the entire population of the town during the three days' duration. At present half of these cars tow trail cars, in order to increase their capacity, and the cars are so crowded that the management of the

Marlborough Company has ordered an additional number of ordinary open cars, so that all the motor cars can draw an ordinary car behind them. At present the road is unable to accommodate all the passengers who desire to travel upon this railway, and the success of the installation is unqualified. It is said that the management of the road are already meditating an increase of their equipment. A. C. S.

WESTERN NOTES.

Branch Office of The Electrical World,
39 Mallers Building, Chicago, June 29, 1889.

Prescott, Ari., is now lighted with electricity.

Watertown, Wis., will soon have an electric light plant in full operation.

H. Ward Leonard, Chicago, returned from an extended trip East on Thursday.

Aurora. Ill., will put all vagrant dogs to death by electricity hereafter—*if possible.*

East St. Louis Citizens favor giving the contract for lighting the city to the bridge company.

Poor Old Rochester, Minn., is to have the business portion of her city lighted by fifty gas jets of 18 c. p. each.

Mr. Geo. Cutter is receiving numerous orders for his adjustable dynamo brush trimmer and for Simplex wire.

The Dog Killing Scheme at St. Paul, Minn., with the aid of a Brush dynamo, proved a dismal failure on the 22d.

The Bernstein Electric Company have appointed George Cutter, 80 Adams street, Chicago, their Western agent.

P. C. Ackerman, the New York agent of the American Electrical Works, called on his friends in Chicago this week.

Waterloo and Cedar Falls, Ia., will soon be connected by an electric railway, a franchise having been granted June 24.

A. C. Wheat, 511 Tacoma Building, Chicago, has recently obtained several good contracts for incandescent house wiring.

The Vicksburg, Miss., Street Railway Company is contemplating changing its mule motive power to electric motors.

A. F. Shuman, Chicago, is erecting five handsome residences on Cornell avenue that will be lighted from an isolated incandescent plant.

P. A. Bennett & Co., Chicago, have added a brass foundry to their factory in order to secure more perfect castings for their specialties.

The Root Electric Gas Lighting Company, Chicago, have received some excellent indorsements of the value of their new burner.

The Commercial Electric Company, 57 Gratiot avenue, Detroit, Mich., have already secured several contracts for installation of plants.

The Board of Commissioners of Cook County, Ill., called for bids on June 26, to be opened July 1, for gas and electric light fixtures.

The Standard Carbon Company, Cleveland, Ohio, have sold nearly two million carbons in the Southern States during the past sixty days.

The Electrical Supply Company find a steady sale for their ball and socket insulating joint, it occupying less space than any other flange joint.

Spencer H. Gale, representing Cassidy & Son, gas and electric fixture manufacturers, has opened an office in Room 11, Metropolitan Block, Chicago.

Eau Claire, Wis., is disturbed over the pole question, some of the citizens objecting to the erection of the poles of the Sprague electric railway system.

The Central Electric Company, Chicago, are mailing to their friends a handsomely gotten up copy of C. C. Haskins' article on "Arc Electric Lights."

The Marr Construction Company issues a card from Minneapolis, where it has a branch office, at room 214, Boston Block, with Mr. T. G. Grier, as manager.

Geo. A. Mayo has leased a factory on the water-power at Rockport, Ill., and will shortly commence the manufacture of motors, switches and electrical supplies.

The Electric Light and Power Company, Litchfield, Ill., will soon have its new power house completed, the new boilers having been already placed in position.

Beaver Falls, Pa., desires an electric street railway to connect with Beaver, and the Westinghouse Electric Company have tendered bids for constructing same.

Chicago's Fire Marshal opened bids, June 27, for furnishing 500 new electric light posts, all complete except the arc lamps. The bids ranged from $23.25 to $60 each.

W. M. Thomas, of the Mather Electric Company, has returned to the city, having completed the installation of the Mather incandescent plant in the California Theatre.

Park Manor, Ill., now a suburb of Hyde Park, but shortly to be annexed to Chicago, is again agitating the question of lighting streets and residences with electricity.

Prof. F. B. Badt, Western Electric Company, Chicago, secured the contract for a 20-arc light plant for the Grand Opera House, Minneapolis, Minn., on the 25th inst.

The Yale & Towne Manufacturing Company, Chicago, are placing on the market some handsome apartment house boxes having electric and speaking tube connection.

The Stillwater, Minn., Electric Street Railway was given a third test on the 25th inst., the result far exceeding the promises and proving satisfactory to the purchasers.

The Pine Bluff Water and Light Company, Pine Bluff, Ark., are reported to have purchased for $100,000 the plant and franchise of the S. W. Light and Improvement Company.

The Mather Electric Company, Manchester, Conn., have just issued a neat circular showing a partial list of plants of the Mather system in operation and in process of construction.

The Wisconsin Central Railway's new depot in Chicago will be lighted by both arc and incandescent lights, but the plans and specifications will probably not be ready before October.

Chas. A. Schieren & Co., Chicago, will place 40 feet of six-inch, 47 feet of eleven-inch, and 190 feet of fifteen-inch double electric perforated belting in the Auditorium Building, Chicago.

President Mulvane, of the Missouri & Kansas Telephone Company, has agreed to make a rate of $60 on all exclusively residence telephones within the city limits of Kansas City, Mo.

The Electrical Supply Company, Chicago, are now making a specialty of electric bell outfits, neatly packed in wooden boxes, for the hardware trade. Full directions accompany each set.

L. J. McCormick, Chicago, is having plans prepared for a sixteen story building to be erected at the southeast corner of Randolph and Dearborn streets, and to contain an electric light plant.

The Fourteen-Story Building to be erected by Rand, McNally & Co., opposite the Chicago office of The Electrical World, will probably contain a combined arc and incandescent plant.

The National Galvanic Battery Company, Cincinnati, have received several strong testimonials in favor of their perforated cups from the Union Switch and Signal Company and others.

A. C. Green, agent for the Jenney Electric Company of Indianapolis, with headquarters at Fayetteville, Tenn., has disappeared and is believed to have been foully dealt with, a press telegram states.

The Andrews Switch will be largely used in the Auditorium building; two single of 1,000 ampères, five double of 750, two single of 600, and seven single of 300 ampères capacity having already been delivered.

The Illinois Belding Motor Company, Chicago, on moving into their handsome office on the ground floor of the Rookery Building, issued a handsome illustrated circular showing views of factory, etc.

The Charles Munson Belting Company, Chicago, have secured an order from the Omaha Motor Company, Omaha, Neb., for 600 feet of 12-inch, 116 feet of 26-inch, and 112 feet of 42-inch dynamo belting.

The Sperry Electric Company's exhibit at the Paris Exposition has attracted much attention, and a private letter received from there states that the Sperry arc light is remarked for the silent, steady light given.

The Woodward Electrical Company, Detroit, have several installations of the Detroit storage battery under way, especially a large plant now being erected for the Western Electric Company, at Galveston, Texas.

The American Aluminium Company, of Chicago, has been formed to extract from kaolin, and to manufacture aluminium; capital stock, $1,000,000; incorporators, Thomas Charlton, Edgar C. Price and Charles W. Vance.

Comical Circulars.—The B. F. Goodrich Company, Akron, O. probably issue the most unique and comical circulars sent out by the trade. Their card illustrating the race won by the aid of the frog has cured many a fit of "the blues."

The Fletcher Improved Sleet Proof Pulley, sold by the Electrical Supply Company, Chicago, is being called for more than ever by the local lighting companies who are now reconstructing their lines in anticipation of a severe winter.

The Lane & Bodley Company, Cincinnati, will furnish a 24 by 48 Corliss engine, main line of shafting, couplings, pulleys, etc., to the Little Rock Electric Light Company, Little Rock, Ark., made necessary by the extension of their plant.

New Orleans, La., contemplates increasing her fire alarm service in the sixth fire department. On the 25th inst. the City Council authorized the issuing of warrants for $23,500, in favor of the Police Telephone and Signal Company, of Chicago.

The Stilwell & Bierce Manufacturing Company, Dayton, O., have issued a circular showing the nature of steam boiler incrustation, the evils arising therefrom, and the best manner of remedying the same, that is worthy of careful perusal.

Beloit, Wis.—The cornerstone for the first building of the Williams Engine Works was laid at Beloit on June 21. This structure will be 88 × 145 feet, and will be located about 100 yards directly west of the plant of the Eclipse Wind Engine Company.

The Telephone Convention.—The Pittsburgh *Dispatch* says: "A national telephone convention will be held at Minneapolis in September. Roll back the tide of fifty years and where was Minneapolis? Where the telephone? Where the mugwump?"

Electric Light Globes will be handled a little more carefully until the glass works start up again, and many station superintendents will regret not having placed larger orders in advance, especially as the globes would not have been invoiced till shipment was requested.

Force Bain has installed in the mines of the Shawnee & Iron Point Coal Company, Shawnee, O., an electric hauling plant constructed in his shops. The "gathering motor" is only of 8 h. p. capacity, yet readily hauls from six to seven loaded cars of two and a half tons each.

The National Boiler Compound Company, of Chicago, has been formed for the manufacture of compounds for the removal and prevention of scale or incrustation in boilers; capital stock, $50,000; incorporators, Peter [illegible]amble, Edward Hurley and Elbert R. De Tamble.

The Central Electric Company, Chicago, has just placed an improved needle annunciator on the market. This company sold the return-call needle annunciators, bells, etc., that were placed in Plank's Hotel, on the beach, and in the Hotel Whitcomb, on the bluff, at St. Joseph, Mich.

The Minnesota River and Rail Electric Company has been formed at St. Paul. Capital stock, $100,000; for the manufacture and sale of electric motors, machinery, etc. Incorporators: Henry H. Fuller, Wm. A. Somers, Frank Dabney, Wm. Dawson, Jr., Wm. Foulke and John J. Flanagan.

Unique Illumination.—There hangs suspended over the entrance to the Chicago office of the U. S. Express Company a gracefully tapering golden dragon, some 25 feet in length, with a seven-forked tongue darting from its widely-distended jaws and bearing on each tip a sixteen candle-power incandescent lamp.

The Wisconsin Telephone Company has abandoned the project of laying creosote wood conduits, and will use fire clay conduits hereafter. They are placing 6,000 feet underground, holding 80,000 feet of cable, the cost approximating about $45,000. The company will also put in a new switch-board costing $3,000.

Rushville, Ind., has won the suit brought jointly against the city, the Edison United Manufacturing Company, and the Buckeye Engine Company, by the Hughes Manufacturing Company, of Cincinnati, owners of the Rushville Gas Company, the decision rendered June 27, stating that the city was legally entitled to its plant.

The Hill Clutch Works have furnished through C. A. Burns, of Chicago, a complete set of clutch pulleys, shafting, etc., to the Decatur, Ill., Gas Light and Coke Company's electric light plant. They are also furnishing a complete outfit for the Fort Wayne Jenney central station plant in the Adams Express Building, Chicago.

The Excelsior Electric Company, Chicago, have a three horse-power motor at work churning "old-fashioned cream into butter," operating a patent churner holding 20 gallons and yielding 225 pounds of delicious butter. The motor also operates a patent "butter worker" working 50 to 75 pounds of butter into condition very quickly.

The Eureka Improvement Company, operating in South St. Paul, Minn., made an assignment June 26. Their electrical interests were practically disposed of several months since, and the loss is due to depreciation in the value of real estate purchased in expectation of securing a franchise to construct an electric motor line through the city.

Denver, Col., will have an electric light plant in full operation on one of the floats in the trades' parade on the 4th of July. The new telephone exchange is eagerly looked for by some hundred citizens who have filed applications for telephones but cannot be accommodated at present. The new exchange will probably contain every modern improvement.

The Consolidated Electric Light Company, of Kansas City, Kan., were denied their application for an order to temporarily enjoin the Metropolitan Street Railway Company from erecting electrical appliances for the Armourdale electric line, Judge Miller holding that the electric light company did not have an exclusive right to the street.

Thomas Lowry, of St. Paul, Minn., has entered into a contract with Archbishop John Ireland and Thomas Cochran, Jr., to construct an electric street railway from Wabash street west, through Reservetown to the Mississippi River, a distance of 5 miles. Mr. Lowry also proposes to turn all his horse-car lines into electric-motor railways as speedily as possible.

The Southern Bell Telephone Company has established new exchange or toll stations at Balton, Clinton, Jackson, New Bell, Bovina and Edmundson, Miss., and the company is building a new line to connect Vicksburg with all towns on the east bank of the Mississippi River. A new telephone cable has been laid across the Mississippi River at Greenville, Miss.

The Thomson-Houston Electric Company have sold during the present week to the Excelsior Hotel Springs Company, Excelsior Springs, Mo., a 300-light incandescent plant; Northwestern Cold Storage and Ice Company, Portland, Ore., a 100-light incandescent plant; also, twelve motors of various horse power to the Denver Electric Illuminating Company, Denver, Col.

Club Notes.—The following visitors were entertained at the club rooms during the week: John H. Finney, St. Louis, Mo.; P. C. Burns, Findlay, Ohio; T. E. McClees, Washington, Iowa; W. R. McKee, New Orleans, La.; B. F. Reed, New York; W. C. Gleason, New York; Frank Bowen, New York; H. W. Hill, Cleveland; W. H. McClintock, West Union, Iowa; P. C. Ackerman, New York; W. H. Patton, Des Moines, Iowa.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations upon telephone stocks as follows:

Chicago	$310@$325	Cumberland	$69@ $70
Central Union	60@ 61	Wisconsin	117@ 118
Michigan	84@ 85	Bell of Missouri	151@ 153
Great Southern	31@ 33	Iowa Union	23@ 25
Colorado	38@ 40	Missouri and Kansas	63@ 65
Rocky Mountain Bell	41@ 42		

Warrensburg, Mo., is still considering the various propositions offered by parties desirous of securing a franchise for installing an electric light and power system. One party has offered to supply the city with twelve Thomson-Houston arc lamps of 2,000 candle power till midnight at $80 each per year, and to light the council rooms free of charge in return for a franchise. Alfred Blaker, of Pleasanton, Kas., has offered to erect a system of water-works as well as an arc and incandescent electric lamp plant in Warrensburg.

The Sperry Electric Company, Chicago, by means of an ingenious device are enabled to operate their 10 ampère lamps on a current of only five or six ampères without causing the slightest hissing in the lamp or sparking at the brushes. The arrangement enables local lighting companies having city contracts to satisfactorily operate the street lighting after midnight at a reduction of 40 per cent. to 50 per cent. in the matter of fuel, which is quite an important saving.

The Stilwell & Bierce Manufacturing Company, Dayton, O., lately shipped eleven car loads of Victor turbines to the Kimberly & Clarke Company's new paper mill at the Cedars near Appleton, Wis., and will probably follow with five more cars. This is probably the largest single shipment of water-wheels ever made. A pair of horizontal Victor wheels for the cable railway at Spokane Falls, Wash. Ter., are now being made, and this company has just completed the installation of two pairs of horizontal wheels at Harrisburg, Pa., for the local electric light plant.

The Payne Automatic Engines have lately been placed by Mr. A. S. Walker, their Chicago representative, on the steamer "Mabel Bradshaw;" one 50 h. p. at the Eagle Laundry, Chicago; one 60 h. p. at the Pullman Palace Car Company's works, Pullman; one 8 h. p. with C. & G. Cooper, Mount Vernon, O.; one 12 h. p. at Chicago Varnish Company's works; one 30 h. p. at Gore's European Hotel, Chicago; one 12 h. p. with the Western office of the Mather Electric Company, Chicago; and one 12 h. p. with H. P. & C. C. Thompson Lumber Company, Washburne, Wis.

The Omaha & Council Bluffs Railway and Bridge Company are progressing rapidly with the electrical equipment of the recently purchased horse car lines in Council Bluffs. For the operation of such lines they have purchased ten additional motor trucks and two generators from the Thomson-Houston Electric Company. In placing this order for additional apparatus, the management of the road state, in a letter to the Thomson-Houston Company, that they consider their present line, equipped with the Thomson-Houston system, the most perfect electric railway in the world.

L. E. Ingalls, Joliet, Ill., states that the bids for lighting the streets of that city have been referred to the committee on lights. The bids are as follows: L. E. Ingalls, Waterhouse system, 82 lights till every midnight, $96; 82 lights till every 4 A. M., $150. Excelsior Electric Company, 75 lights all night, $118. Thomson-Houston Electric Company, 75 lights all night, $140; 75 lights, moonlight schedule, $110. Mr. Ingalls has just invested a large amount of capital in improving his plant, and he doubts the wisdom of the policy shown by the different parent companies in contesting so bitterly for the city lighting.

The Elmer A. Sperry Company, manufacturers of special electrical apparatus, motors, etc., the Standard Electric Light Company, and the Belding Motor and Manufacturing Company, occupying various floors in the Burton Block, Chicago, were heavy losers by a fire that entirely destroyed the big manufacturing block about 5 A. M, June 28th. Much sympathy is extended to the unfortunate companies, though they are too busy laying plans for the future to do aught but hustle at present, but they will probably set aside a day in the coming month in which to receive and reply to personal letters of condolence.

Hyde Park., Ill., granted a franchise June 24 to the Thomson-Houston Electric Company to erect and maintain an electric light plant. The company will be obliged to furnish a bond of $20,000, and will pay the village, or its successor, $5,000 liquidated damages if the plant be not established, and $10,000 worth of work done

within a year. An electric light franchise was also granted last February to the Hyde Park Electric Light and Power Company, who proposed to use the Sperry system. As Hyde Park will probably soon become part of Chicago these franchises have a certain value. The village is now paying $16 per year for each 16 c. p. gasoline lamp. On June 27 the trustees of Hyde Park awarded the contract for the small electric light plant at the water-works to the Thomson-Houston Electric Company for $920.

Theodore P. Bailey, Western manager of the railway department of the Thomson-Houston Electric Company, received a message Thursday from General Manager S. A. Barton, stating that the contracts were signed for placing their system on all the West End lines in Boston. In consequence Mr. Barton's "boys" were highly elated. Mr. Bailey has closed the contract for constructing four and a half miles double track railway at Peoria. It is intended to make this entire plant the most complete and perfect in the world. The rolling stock will consist of fifteen vestibule coaches to start with; the power station will be a solid, handsome structure, of 500 h. p. capacity, with 250 h. p. Allis-Corliss engines. Mr. Bailey makes it clear to his patrons that power station, road bed, rolling stock, etc., must be perfect in every respect before the Thomson-Houston system will be placed on the line. The Seattle Electric Railway and Power Company have increased their plant by eight cars and two 80 h. p. Thomson-Houston generators.

The Bernstein Electric Company has found it necessary to establish a Western agency in order to properly handle its rapidly growing business in that section, and its choice of a representative has been Mr. George Cutter, of No. 80 Adams street, Chicago. The selection is a good one, as Mr. Cutter is very well known in electrical circles as an active, pushing man of large experience. The goods of the Bernstein Company have earned a national reputation, and the arrangement just completed is certain to result in their general introduction throughout the West. The company has long made a specialty of series incandescent lamps and fittings and that its goods are "made upon honor" is evidenced by the rapid growth of its business. Its series socket of insulating material is unique in its way, and the automatic cut-out included in it is said to be so perfectly certain in its action as to have received the unqualified approval of the insurance interests. A complete line of the company's goods will be kept at the Chicago office, where full information may be obtained.

Des Moines, Ia.—The popularity of electric railways is evidenced by the recent purchase of the Des Moines Broad Gauge Railway, equipped with the Thomson-Houston system by a wealthy Chicago syndicate, the purchasing price being $350,000, some three times the original cost of the road. When equipped with horses this road did not pay operating expenses, but since its equipment and operation under the Thomson-Houston system, its net earnings will pay 8 per cent. dividends upon an investment of nearly $400,000. The road has never had a repair shop for its electrical apparatus, and in a recent conversation its president said that they did not know what electrical repairs meant, as they had had none to make. In some respects the Des Moines road has been the most wonderful in results of any electrically equipped road, it having at its power station but one 80 h. p. generator, which operates 8 cars over grades running as high as 10 per cent., without indications of overheating, and frequently tow cars are used with those equipped with motors. On one branch of the system the necessity of speedy equipment compelled the use of a No. 2 copper wire without feeders, such wire being the only available material; yet with this small conductor the cars are run at a rate of six miles per hour up a 10 per cent. grade, three miles distant from the station. D.

ENGLISH NOTES.

(*From our own Correspondent.*)

LONDON, June 21, 1889.

The Edison Incandescent Lamp Patents.—At the forthcoming exhibition at Birmingham Dr. Woodward, of Toronto, will send over a very early incandescent lamp for which he took out a patent dated well back in the seventies. It is stated that Dr. Woodward's relations with Mr. Edison were at one time exceedingly intimate, and Mr. Edison was supposed to have purchased this patent, which perhaps accounts for our not having heard of it until the present time. Dr. Woodward now states that the purchase was never completed; should this prove to be so Dr. Woodward's patent will play a prominent part in the litigation which is now going on between the various owners of incandescent lamp patents.

Reception of, and Dinner to, Prof. Elihu Thomson.—On Wednesday evening last Prof. Elihu Thomson, President of the American Institute of Electrical Engineers, was welcomed on his arrival in England by a reception and dinner at the Ship Hotel, Greenwich. The professor was received by a few words of cordial welcome from the chairman, Colonel Martindale, followed by Sir William Thomson, Sir Frederick Abel and Mr. Swan. After a brief reply in well chosen words from Professor Thomson, the company, numbering about forty-six, sat down to dinner. The toasts proposed by the chairman were "the Queen." "the President of the United States," "Prof. Elihu Thomson," after which Dr. Merz wished "Prosperity to the Thomson-Houston system," and Mr. Wharton gave "Our Guest." The professor returned thanks. Mr. Meech, of the Thomson-Houston Company, replied on their behalf, and Mr. Moulton, Q. C., for the guests. The occasion will long be remembered by those who were privileged to be present as one of the most interesting and enjoyable events of the year.

The Amalgamation of the Telephone Companies.—The proposal to amalgamate the United with the National and the Lancashire and Cheshire Telephonic Exchange companies has produced a letter from the postmaster-general calling in question the right of these companies to amalgamate under the terms of the licenses granted by the post-office. In reply to the postmaster-general the United Telephone Company sent a letter on the 14th inst., pointing out that under the joint stock companies acts they have a perfect right to liquidate and sell their business to any other company similarly registered, if they choose to do so. If, therefore, the postmaster-general had desired to stop such an arrangement a special clause to that effect should have been inserted in the licenses at the time they were granted. Indeed, it is pointed out that a clause was inserted by the solicitor to the post-office which distinctly contemplated the purchase by one company, holding a license from the postmaster-general of the business of another company holding a similar license, and thus that the possibility of an amalgamation such as is now proposed was distinctly contemplated by the postmaster-general in office when the original licenses were granted. Furthermore, that on three distinct occasions since the granting of these licenses, companies or persons holding licenses to carry on the telephone exchange business have transferred their exchanges to other companies holding similar licenses without the slightest objection being raised by the postmaster-general. To this letter from the United Telephone Company the postmaster-general has not yet replied, but it would certainly seem as though he had directed the communication from the post-office to be written without first making himself fully aware of what the various licenses actually contained.

The Gas Companies and the Electric Light.—On the 6th inst. a Board of Trade inquiry was opened in Dublin to hear an application by the gas company to open certain streets for the purpose of lighting a portion of the city with the electric light. The application was opposed by the corporation. The inquiry has raised a question the importance of which can hardly be exaggerated. The gas company claims that their act of 1866 empowers them to adopt "improved means of lighting," which they maintain necessarily includes lighting by electricity, and that they consequently have statutory powers to do everything except open up the streets. When the question was brought before him, the inspector of the Board of Trade stated that it was in no way his duty to attempt a legal interpretation of the sections of their act referred to, and that consequently he would merely treat the application as though it were an ordinary case. Shortly after the passing of the Electric Lighting Act of 1883 the Liverpool Gas Company set up a similar claim, which was then allowed by the Board of Trade. As, however, the Liverpool company never attempted to make use of the powers it then laid claim to, the point cannot be said to have ever been decided, and, indeed, appears to have been entirely overlooked until the present inquiry. There are doubtless many other gas companies which have similar clauses in the Acts, and may, therefore, have the right to use "improved means of lighting;" so that if it should be finally settled that such companies may supply electric current as well as gas for lighting or other purposes they will be entirely exempt from those clauses of the Electric Lighting Act that bear so heavily on electric lighting companies. Indeed, such are the anomalies of the law that the Electric Lighting Acts, which were passed for the very purpose of preventing a monopoly, will give the gas companies a greater monopoly than ever by placing restrictions on any new company formed for supplying electric current alone which cannot be enforced against the gas companies should they choose to compete with the electric companies for the supply of the electric light.

THE TELEGRAPH.

T. M. B. A.—Assessment No. 231 for July has been made for $1 to meet the death claims of J. B. Larente, W. S. Heldebrand and R. B. Pearson.

The Honolulu Cable.—A special dispatch from San Francisco of June 17 says: The *Evening Post* of to-day states that $1,000,000 has been subscribed for the proposed cable between Honolulu and San Francisco, and that the work of laying the cable will be commenced within eighteen months.

THE TELEPHONE.

The Federal Telephone Company of Montreal suffered damage to the estimated extent of $25,000 by a fire last week.

Helena, Ark.—The Helena & Old Town Telephone Company has been formed with J. T. Brame as president, and J. W. Clopton, secretary.

The Edison Phonograph Toy Manufacturing Company has called a meeting at Portland for July 3 to raise its capital from $600,000 to $1,000,000, in order to make necessary arrangements for foreign business, and to carry out a new contract with Mr. Edison, who is to do the manufacturing. It is said that the company has orders for 500,000 to 600,000 dolls, to be delivered at the rate of 100,000 a year. Mr. Edison is to receive 14,000 shares of the new stock.

THE ELECTRIC LIGHT.

Navasota, Tex.—Mr. E. L. Budges will buy a dynamo, high speed engine, etc.

Waco, Tex.—The Waco Gas Company proposes to put in an electric light plant.

Waycross, Ga.—Mr. M. Albertson is forming a company to put in an electric light plant.

Charlotte, N. C.—The Charlotte Gas Light Company will put in an electric light plant.

Newberry, N. C.—Dr. W. E. Pelham is interested in a project to put in an electric light plant.

Talladega, Ala.—The Talladega Gas, Light and Water Company is to put in an electric light plant.

Middlesborough, Ky.—The Orient Electric Gas and Water Company, will put in a Thomson-Houston plant.

Florence, N. C.—The Florence Light and Power Company has now incorporated with a capital stock of $10,000.

Gibson's Station, N. C.—The State Line Oil and Fertilizer Company will buy an incandescent plant for a new cotton seed oil mill.

Haywards, Cal.—The Haywards Electric Light Company has put in a 10 × 18 × 10 Westinghouse compound engine to run its plant.

Westinghouse Engines to the amount of 1,000 h. p. were ordered during the first six days of June. The May business footed up 4,500 h. p.

Sumter, S. C.—Mr. D. J. Auld wishes to buy steam and electric plant for arc and incandescent lighting for the Sumter Electric Light Company.

Tokio, Japan.—The Tokio Electric Light Company, to meet the demands of a growing business, propose to increase its capital from $250,000 to $500,000.

Springfield, Mass.—The Boston & Albany Railroad is putting an Edison plant in its depot, to be driven by two 65 h. p. Westinghouse compound engines.

Council Bluffs, Ia.—The Council Bluffs Electric Light and Power Company are enlarging their plant and have put in two more Westinghouse engines of 60 h. p. and 125 h. p.

Mayfield, Ky.—The Mayfield Water and Light Company are to furnish the city with water and light for 25 years at $2,400 a year, and will shortly begin the construction of an electric light plant.

Stern & Silverman, of Pittsburgh, have been awarded the contract by the McKeesport Light Company for the furnishing of the arc light system for the lighting of the streets of McKeesport, Pa.

Chattanooga, Tenn.—The Tennessee Electric Light Company, with a capital stock of $100,000, has obtained an exclusive underground franchise for Chattanooga. Mr. A. M. Johnson is president.

Bramwell Court House, W. Va.—The Bramwell & Pocahontas Electric Light Company has been formed by J. H. A. Price, T. S. Heuntz and others, with a capital stock of $15,000 to light Bramwell, Pocahontas and Coopers.

The Elgin National Watch Company, Elgin, Ill., have awarded a heavy contract for electric lighting to the Edison Company, and for their power plant, consisting of two 200 h. p., and one 75 h. p. engines to Westinghouse, Church, Kerr & Co.

Westinghouse Interests.—It is currently reported that there is a movement on foot to consolidate in one the various Westinghouse electrical interests, now so numerous, and to call the new corporation the Westinghouse Electric and Manufacturing Company. Preliminary steps with this end in view have already been taken. The united company will control enormous capital, plant, etc.

The Westinghouse Electric Company, since June 6, have received orders for alternating current central station outfit, as follows: Nashville, Tenn. (increase), 750 lights; Sterling, Ill., 1,000 lights; Butte, Mont., 750 lights; Denver, Col. (increase), 1,700 lights; New York Safety Light, Heat and Power Company (increase), 6,000 lights; Pottsville, Pa., 1,500 lights; Texarkana, Tex., 750 lights; Kankakee, Ill., 750 lights; Mexico, Mo., 750 lights; Stapleton, S. I., N. Y. (increase), 750 lights.

Slattery System in Baltimore.—The Waterhouse Electric Company, of Baltimore, Md., has been awarded the contract for lighting the new post office in the United States Court House building of that city, and they have contracted with the Fort Wayne Jenney Electric Light Company for the Slattery induction alternating system. Messrs. McDonald and Adams, of the Fort Wayne company, were in Washington and assisted in getting the contract for the Waterhouse Company. The number of lights to be used is about 1,700, and the current will be supplied from the central station of the Waterhouse Company, who propose putting in a large number of lights.

APPLICATIONS OF POWER.

Denison, Tex.—A Thomson-Houston plant is to be put in at once, and an electric railroad constructed.

Macon, Ga.—The Macon City & Suburban Street Railroad will, if sold to St. Louis parties, now negotiating, be operated by steam dummies or electric motors.

Atlanta, Ga.—The Atlanta, Woodward & Fenley City Railroad Company will build a road from Atlanta to Fenley City, and has the power to use electric motors.

Boston, Mass.—It is understood that the West End Company has now closed a contract with the Thomson-Houston Electric Company for the equipment of its whole system by electricity.

Louisville, Ky., is on the whole very much pleased with its new electric railway of the Thomson-Houston system, on the Green street line. It is remarked that the introduction of electricity has already greatly improved the character and appearance of Green street.

The Love Electric Railway Company has been formed at Portland, Me., with a capital stock of $2,000,000. Mr. C. F. Hollis, of Newton, Mass., is the president, and Mr. J. C. Love, of Philadelphia, the patentee, is the treasurer.

Cleveland, O.—The Cleveland *Press* of June 26 says: To set the poles and string the wires for two miles of electric road in twenty-four hours' time is hustling, to say the least, but nevertheless the East Cleveland Railroad Company did that very thing in the twenty-four hours ending Tuesday at ten o'clock. Trial trips were made as far as Erie street at noon, and the system was found to be perfectly satisfactory in every particular.

The Auburn & Owasco Lake Electric Railway Company has been formed to run from the intersection of Owasco street and East Genesee street, Auburn, along Owasco street and road to Owasco Lake, a distance of three miles. The capital stock is $50,000. Stephen D. Lake, Walter S. Wales, A. E. Matthews and Hiram McGonigle, of Syracuse; William Bench, of Owasco, and J G. Knapp, Byron C. Smith and John Lenehart, of Auburn, are among the directors of the company.

An Electric Railway Association.—A special dispatch from Davenport, Ia., of June 21, says: A number of officers and managers of electric street railways from all over the country are here to organize an association in the interest of electric railways. Several topics were discussed to-day after a temporary organization had been effected. The association, when permanently organized, will be one of the strongest in the country, having representatives in every part of the United States.

PERSONALS.

Mr. David Brooks sails for Europe next week by the "City of Paris."

Prof. R. T. Ely, of John Hopkins University, contributes to the *North American Review* for July an article on "The Telegraph Monopoly," in which he proposes a world's telegraph union, after the style of the universal postal union.

Mr. C. J. Reed, of the electrical staff of the Indianapolis Jenney Company, and a young electrical engineer of unusual promise, has recently been on an eastern trip. Mr. Reed has made a specialty of questions connected with incandescent lighting.

Mr. J. McKearney, formerly in the service of the Brush Company, and known in the East, is now doing expert work for the Western office of the Thomson-Houston Company. He has just finished a 100 arc-light plant at Beardstown, Ill., for street lighting, and is now constructing another plant at Hyde Park, Ill.

Mr. C. L. Buckingham has a very interesting article in the July *Scribner* on modern telegraphy, profusely illustrated with views, diagrams of circuits, etc. We imagine that some careful electricians will be rather amazed and amused at the extraordinary tangle of wires shown to exist under the big switch-board at "195." From the fact that the cut is shown of it, the inference is natural that the company is rather proud of the mess.

Mr. J. H. Vail, so well known in electrical circles as the chief of the engineering department of the Edison Electric Light Company up to the time of its recent change of name, etc., has now placed his great experience and remarkable executive ability at the disposal of his energetic old chief, Mr. E. H. Johnson, in connection with the work of the Sprague Company and several other leading electrical enterprises. Mr. Vail's official title will be assistant to the president.

Mr. H. Ward Leonard has, we understand, accepted the general management of the new General Edison Electric Company, with headquarters in New York. Mr. Leonard has long been a conspicuously successful Edison representative in the West, but will now have an even broader field for the display of his ability. It is stated that he will bring with him to New York from Chicago Mr. A. Vance as his chief assistant, and that Mr. W. S. Andrews will go from Minneapolis to take charge of the Chicago office.

MISCELLANEOUS NOTES.

Help for Johnstown.—Our Paris correspondent writes that the Edison employés at the Centennial Exposition subscribed 380 francs to the fund for Johnstown.

The Standard Electrical Subway Company has been formed in this State, with offices in New York, by J. J. Wilson, E. B. Halsted, H. L. Kennedy and others, with a capital stock of $250,000.

Pleading for Kemmler.—Mr. Bourke Cochran made his argument at Auburn, N. Y., on June 25, before Judge Day, to have the sentence of Kemmler to death by electricity set aside on the ground that the mode of execution is cruel and unusual, and therefore unconstitutional. Evidence on the point is to be taken.

Aging California Wine.—According to the San Francisco *Call*, Mr. F. M. Speed, of San Francisco, is now aging California wine successfully by winding coils of wire around the barrels and passing a current of considerable strength through the coils for about three weeks. The casks in use are 108 inches high and 45 inches in diameter.

The Page Belting Company, of Concord, N. H., are just completing important and extensive additions to their works. An entirely new and large mill building has been erected, which will greatly increase their capacity. New water-works have also been put in, including a very large tower reservoir, and important additions have been made to their belt factory and other departments. They have also put in machinery for the manufacture of metallic tipped belt laces, which they are now making on an extensive scale. They report a very large increase of business over last year.

BUSINESS NOTICES.

City Gas Light Company, of Norfolk, Va., say that "Schieren's *perforated* belts are *by all* odds the *best* belt for dynamos they have ever used." Chas. A. Schieren & Co., manufacturers, New York, Boston, Philadelphia, Chicago.

Patterson, Jordan & Gottfried, 146-150 Centre street, carry a complete stock of brass and iron machine and wood screws, cap and set screws, all kinds of bolts, taps, files, twist drills, brass and rubber tubing, brush copper, rod and sheet copper, brass rods, sheet German silver, sheet brass, machinery, tools, hardware, etc. Electric motor supplies.

The Curtiss Regulator Company, of Boston, Mass., report larger and increasing sales of their patent damper regulator both at home and abroad. They are constantly in receipt of communications similar to the following:

MUNCY WOOLLEN MILLS,
MUNCY, Pa., June 22, 1889.

Mr. Nelson Curtiss, Boston:

DEAR SIR: Your favor of the 19th inst. to hand, and in reply would say that we ordered one of your damper regulators through Mr. J. J. Luzerlan, and have attached it to our boiler, and must say that if it keeps on working as it does now, it will please us to our entire satisfaction. It opens and closes on one-pound variation.

Yours truly, COULTER, ROGERS & Co.

The Pond Engineering Company, through their Kansas City representative, have lately sold to John W. Norton, of Kansas City, for the Vine Street Motor Line, a steam plant, consisting of a 100 h. p. boiler, and 80 h. p. Armington & Sims engine, with the necessary pipe work, pumps and heater, set up ready for operation.

The Clayton Air Compressor Works, of Brooklyn, have contracted to furnish two large duplex gas compressors, with boilers etc., to the Kentucky Rock Gas Company. The compressors will have a capacity of 2,000,000 feet per day, and at a pressure of 200 pounds per square inch will force gas a distance of 32 miles, to Louisville.

The Ball Engine Company, in addition to their enormous trade in furnishing electric light engines, are having quite a demand for engines for operating electric street railroads, and have furnished the following roads with engines: Austin Water, Light and Power Company, Austin, Tex.; Highland Park Electric Railway Company, Detroit, Mich.; Eckington & Soldiers' Home Electric Railway Company, Washington, D. C.; South Side Street Railway Company, Cleveland, Ohio; Central City Passenger Railway Company, Louisville, Ky.; Mt. Auburn Incline Railway Company, Cincinnati, Ohio; Cincinnati Street Railway Company, Cincinnati, Ohio; Akron Electric Railway Company, Akron, Ohio; Erie City Street Railway Company, Erie, Pa.; Melbourne Exposition Electrical Tramway, Melbourne, Australia; Box Hill & Doncaster Electrical Tramway, Melbourne, Australia; Binghamton Electric Railway Company, Binghamton, N. Y.; Lynn Electric Railway Company, Lynn, Mass.; Electro-Automatic Transit Company, Baltimore, Md.; Buffalo Street Railway Company, Buffalo, N. Y.; New Birmingham Street Railway Company, New Birmingham, Tex.; Vandepoele Electric Street Railway Company, Windsor, Ont.; Atlantic City Street Railway Company, Atlantic City, N. J.; Willamette Bridge Street Railway Company, Portland, Oregon; Metropolitan Passenger Railway Company, Portland, Oregon; Bay Ridge Reservoir Company Electric Railway, Bay Ridge, Md.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

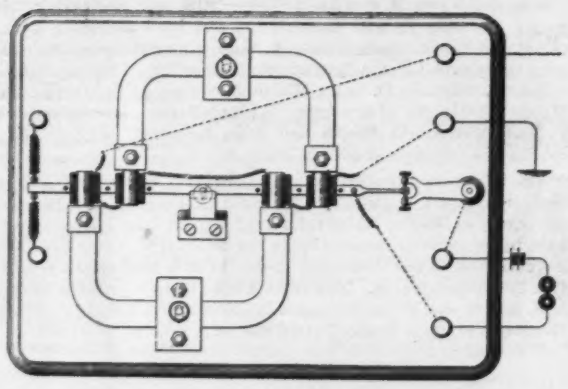
PATENTS ISSUED JUNE 25, 1889.

405,742. Electrolier; John M. Orford, of Bridgeport, Conn. Application filed Feb. 20, 1889. In an electrolier, the combination, with the ceiling block and the hanger hinged thereto, of a canopy adapted to fit against the block and open as to its lower end, a cover plate arranged around the hanger and conformed to the contour of the canopy adapted to fit against the block and open as to its lower end, a cover plate arranged around the hanger and conformed to the contour of the canopy, and means as a ring and binder screw, arranged upon the hanger, whereby the cover plate is retained against the canopy and the latter against the ceiling block.

405,743. Regulator for Dynamo Electric Machines; James Hart Robertson, of Rutherford, N. J., Assignor of three-fifths to Theron A. Richards and John Robertson, of Brooklyn, N. Y. Application filed May 17, 1888. In a regulator for dynamo electric machines, the combination, with a helix arranged apart from the dynamo in the main line of a circuit, of a core capable of magnetic induction and controlled by said helix, and a conductor placed on said core and in shunt with the main line, whereby the resistance of the shunt is decreased in proportion to the decrease of resistance in the main line.

405,750. Standing Contact Arm; Chas. J. Van Depoele, of Lynn, Mass. Application filed March 27, 1889. The combination of a suitable support located centrally upon the top of an electric railway car, and a contact-carrying arm mounted at its lower extremity in a hinge in said support, the hinge having a limited rotary movement thereon, whereby the arm is rendered movable in an arc including either end of the car.

405,751. Secondary Battery; Jean Theodore Van Gestel, of New York, N. Y. Application filed Oct. 2, 1888. An electrode for a secondary or storage battery composed of a single piece of conducting metal, having shelves for the active material, the shelves



405,988. TELEGRAPH INSTRUMENT.

being located on the opposite faces of the electrode in alternate succession, and all in the same vertical plane. See illustration.

405,767. Conduit for Cable or Electric Railways; William John Brewer, of New York, N. Y., Assignor of three fifths to Thomas W. Rae, Frederick H. Reed, Walter Thompson and George N. McKibben, all of same place. Application filed Aug. 7, 1888. The combination of a conduit, inclined transverse braces, an inclined longitudinal strip supported by the braces, a conductor secured to the strip, and a beveled contact wheel or brush.

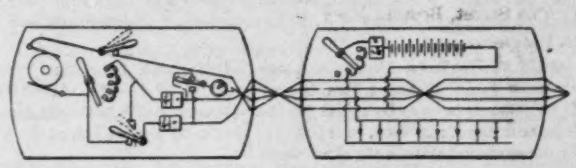
405,815. Electrical Railway Signal; James Collord White, of Sewickly, Pa. Application filed Jan. 10, 1889. In an electric railway signal, the combination, with a railroad track divided into sections insulated from each other, of four contact rails arranged in pairs in each section, and connected together and to the track rails of the next section, one pair of the contact rails being opposite the joints of the sections, hangers suspended from the locomotive, contact wheels journaled to the hangers, a bell and battery on the locomotive, and wires extending from the hangers to the bell and battery.

405,831. Electric Signaling System; Mark W. Dewey, of Syracuse, N. Y., Assignor, by Direct and Mesne Assignments, to the Dewey Corporation, of same place. Application filed March 15, 1889. The invention consists, partly, in electrically operating or controlling motors at the receiving stations by a controlling motor at one of the receiving stations or a central station, so that all of the motors will operate synchronously to rotate the trailing fingers which traverse corresponding circular tables of contacts, and cause said fingers at the respective receiving stations to pass simultaneously on corresponding contacts. The contacts are insulated from each other and connected by separate branch wires with the magnets of the annunciators and lines.

405,858. Electro Magnetic Motor; Nikola Tesla, of New York, N. Y., Assignor to the Tesla Electric Company, of same place. Application filed Jan. 8, 1889. An electro magnetic motor consisting of a field magnet, a rotary armature, and a single coil adapted to be connected to a source of alternating currents, and to impart magnetism to both the armature and the field magnet with angular displacement of the maximum points. See illustration.

405,867. Telephone Exchange Apparatus; Franklin G. Beach, of Chicago, Ill. Application filed Dec. 8, 1887. A spring jack switch provided with a line terminal, the normal contact of said line terminal, a test spring insulated from the line terminal, and a connection for the return portion of a circuit in combination with a loop plug inserted in the switch, whereby the line spring is separated from its normal contact and closed to the tip of the plug, while at the same time the connection of the switch is closed to the sleeve of the plug.

(1) 405,895. Combined Track and Train Lighting; (2) 405,896. Electric Lighting System; (3) 405,897. System of Electric Lighting for Railway Cars. (1) and (2) Harry Ward Leonard, of Chicago, Ill., and (3) Henry Ward Leonard and Augustus Hanson, of Chicago, Ill., said Hanson Assignor to said Leonard. Applications filed (1) Feb. 7, 1889; (2) Jan. 19, 1889; (3) Jan. 31, 1889. (1) and (2) The combination of a series of

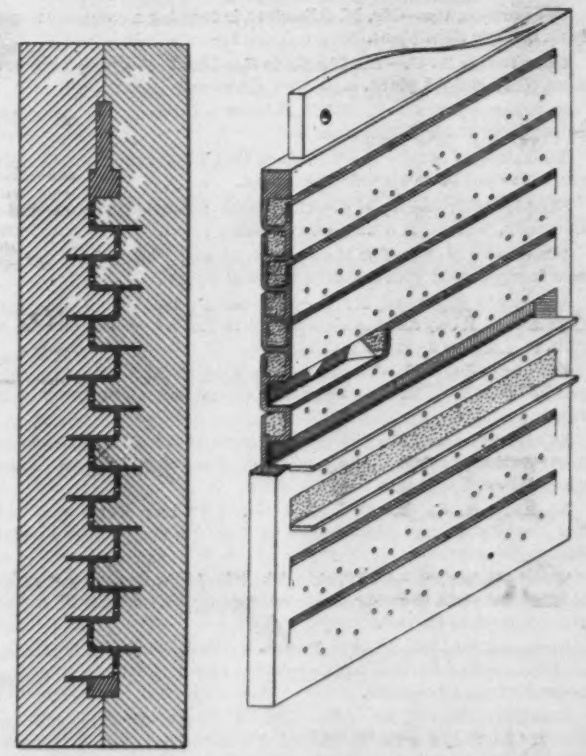


405,897. SYSTEM OF ELECTRIC LIGHTING FOR RAILWAY CARS.

cars with a series of conductors therealong, so arranged that the terminal of each is on the opposite sides of each of the other terminals at the two ends of the car, and a connector provided with wires so arranged that the conductors of one car are connected each with the oppositely arranged conductors on the adjacent car. (3) The essential feature of the inventions is their applicability to the lighting of railroad tracks from, and by means of generators, particularly dynamos and storage batteries, on a moving train. See illustration.

405,906. Electric Arc Lamp; Henri Pieper, Fils, of Liege, Belgium. Application filed Feb. 4, 1889; patented in Belgium, Feb. 5, 1888. The object of the invention is to produce the regulation of the length of the arc in electric arc lamps by means of the difference of speed of two motors, obtained through the variations of the current. For this purpose the two motors are so connected to the carbons that the one is adapted to increase, the other to decrease the distance between the latter, and one of them, or both, are arranged to be in their operation dependent on the electric current.

405,964. Automatic Electric Controller for Railroad Trains; Frank E. Kinsman, of New York, N. Y. Application filed Aug. 17, 1886. Renewed May 1, 1888; again renewed Dec. 13, 1888. The invention consists in a means for causing the brakes to be gradually applied, the essential features of which consist in the employment of a motor device of any desired kind that is connected with the brake-controlling appliance through a reducing gear, or has its movements otherwise retarded or controlled,



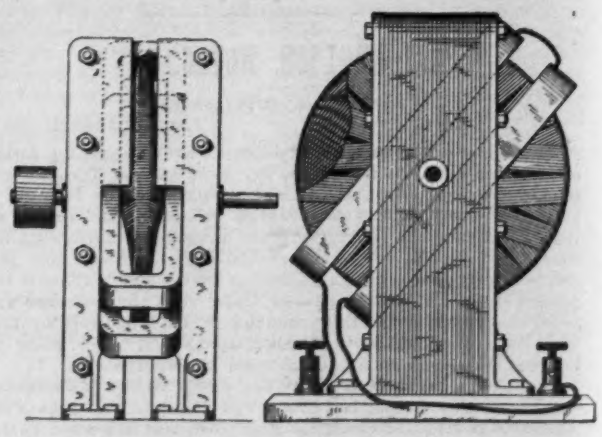
405,751. SECONDARY BATTERY.

so that the brake-controlling appliance—such, for instance, as the controlling cock of an air brake—shall be moved gradually; and in controlling the action of the motor by a magnet brought into action or governed in such ways as to cause the motor to operate on the occurrence of abnormal conditions requiring the application of the brake.

405,970. Adjustable Support for Incandescent Electric Lights; John T. Pearson, of St. Louis, Mo., Assignor to Harvey S. Page, of same place. Application filed Feb. 2, 1889. This is a device by which an incandescent light may be supported at various elevations or the conducting cord extended to any length within a given limit.

405,978. Electrically Propelled Vehicle; Richard N. Allen, of Cleveland, Ohio. Application filed March 11, 1889. The combination, with the motor shaft and car axle, both provided with friction pulleys or drums, of a pivoted lever or frame, friction wheels carried thereby and adapted to be brought by the frame into contact with both pulleys or drums, and an adjustable spring connection between the frame and a fixed support, the tension of which acts to force the friction wheels against the pulleys and drums.

(1) 405,984. Telegraphy; (2) 405,985. (3) 405,986. (4) 405,987, (5) 405,988. (6) 405,989. Telegraphic Instruments. Charles G. Burke, of Richmond Hill, Assignor to Frederick Wolffe, Trustee, of New York, N. Y. Applications filed (1) Aug. 4, 1888. (2) Sept. 8, 1888. (3) Oct. 13, 1888. (4) Jan. 17, 1889. (5) Jan. 18, 1889. (6) March 28, 1889. (1) At the receiving end of the line two relays or magnets of peculiar construction are arranged to be both normally in the circuit of the main line, and capable of responding to the impulses transmitted, each relay being arranged to operate a local circuit. Again, these relays are so arranged that by the operation of either, the other one is cut out of the line and restored at the end of such operation. (2) In a circuit-closing device, the combination of a main arm and two auxiliary arms frictionally attached thereto, said auxiliary arms carrying circuit-closing points, which are caused to simultaneously approach or separate from each other by the motion of the main arm. (3) A compound telegraphic receiving instrument having two coils upon independent centres, movable simultaneously in fields of force, each coil carrying an arm, said arms being attached to the axle upon which the coil turn, and which are caused to simultaneously approach or separate from each other by the motion of said coils. (4) The invention consists, generally, in a solid coil of wire, which forms part of the main circuit, wound in the shape of a disk and suspended within a field of force formed by one or more magnets, motion of the coil being caused by the currents passing over the line. (5) In a telegraphic instrument, two pair of coils or solenoids connected in the line, said coils being affixed to a pivoted bar, one pair upon each side of the pivot, and two magnets having their poles on each side of the pivot and extending within



405,858. ELECTRO-MAGNETIC MOTOR.

said coils. (6) The invention consists, generally, in a cylindrical coil of wire, which forms part of the main circuit, suspended perpendicularly within a field of force effected by one or more magnets, motion of the coil being formed by the currents passing over the main line, of which it forms a part.

406,010. Electric Meter; Elihu Thomson, of Lynn, Mass. Application filed Oct. 19, 1889. The invention consists in the combination, with a liquid containing receptacle holding a vaporizable liquid, of an electric conductor forming a portion of an electric circuit and adapted to heat said liquid, and a second chamber for collecting the condensed vapor evolved by the heating of the liquid by the electric conductor.

406,015. Dynamo Electric Machine; Thomas L. Wilson, of Brooklyn, Assignor of one-third to Grosvenor P. Lowrey, of New York, N. Y. Application filed Jan. 9, 1888. The combination, with a commutating armature consisting of segmental bars arranged spirally around a core, and field magnets having polar ends radially approaching the exterior circumference of said armature on opposite sides of brushes bearing directly on the external peripheral segments of said commutating armature at the exposed portions between the radially approaching magnet poles.

PATENTS EXPIRED JUNE 25, 1889.

128,201. Improvement in Electrical Lighting Attachments for Gas-Burners; Henry C. Appleby, of Conneaut, Ohio. The invention consists in connecting an electrophorus to a gas-burner in such a manner that, by separating the plates of the electrophorus the conducting wires are raised to the lighting point of the gas, and by pushing the plates together the conducting wires are brought down close to the orifice of the burner, and at this point they are not acted upon by the heat of the flame to such an extent as they would be were they allowed to remain at the lighting point of the gas.

128,405. Improvement in Automatic Telegraph Transmitters and Receivers; George Little, of Rutherford Park, N. J. The motor-shaft in combination with connections through that shaft to the magnets.

128,427. Improvement in Circuit-Changer; James Rowe, of Paterson, N. J. A soft iron armature swinging from one position to the other on an electro-magnet when the polarity of the electric circuit is changed and retained alternately by induced magnetism.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.

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